BULLETIN OF THE

TAYLOR SOCIETY

AN INTERNATIONAL SOCIETY TO PROMOTE THE SCIENCE
AND THE ART OF ADMINISTRATION AND OF MANAGEMENT

First Section　**Annual Meeting Report**

Technological Unemployment

By PAUL H. DOUGLAS

Maintenance of Standards

By VICTOR S. KARABASZ

Engineering Societies Building
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New York

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2. To secure the gradual elimination of unnecessary effort and of unduly burdensome toil in the accomplishment of the work of the world.

3. To promote the scientific study and teaching of the principles governing organized effort, and of the mechanisms of their adaptations and application under varying and changing conditions.

4. To promote general recognition of the fact that the evaluation and application of these principles and mechanisms are the mutual concern of the community, the worker, the manager and the employer.

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SPRING MEETING

Philadelphia, Pa.

April 30, May 1, 1931

Planning in Various Areas of Responsibility

Comment

IT IS the experience of those concerned with conventions that they ask themselves after an unusually successful one how they can ever succeed in organizing another which is as good. That was our feeling a year ago. Yet the recent convention of December, 1930, appears to have been the most satisfactory of all. The registered attendance was over 600 and voluntary expressions of satisfaction more numerous than ever before.

BECAUSE the material was readiest for publication, we give our readers in this issue the paper of Dr. Douglas on Technological Unemployment and that of Dr. Karabasz on Maintenance of Standards. This makes a good balance, for the one is concerned primarily with facilities and methods, the other with managerial policy. The problem of maintenance of standards is not new, but it is important that there be continuous attention to the subject, for maintenance of standards lies at the very heart of scientific management and is generally very inadequate. Therefore Dr. Karabasz' paper should receive studious attention.

DR. DOUGLAS' paper presents a technique for measuring the variability of industries and their susceptibility to variation in employment. It is something new, the statistical computations limited, and the technique needs validation; yet it was evident that the audience believed that Dr. Douglas had "started something," for we had never observed an audience, not composed of statisticians, which listened with such marked interest to a mathematical paper. It was evident that the audience believed in measurement, and was willing to applaud an effort to measure phenomena heretofore assumed to be immeasurable.

THE papers and discussions of the other sessions will appear in following issues of the BULLETIN: the discussions of elimination of distribution waste; of balance sheets of management to supplement financial statements; of the industrial code in process of formulation by a committee of the Society—already appraised as "a landmark in American industrial history"; of the proposition that business organization and technological organization have got so out of gear that some form of voluntary self-government in industry is necessary to bring them into harmony; and other subjects.

Technological Unemployment[1]

Measurement of Elasticity of Demand as a Basis for Prediction of Labor Displacement

By **PAUL H. DOUGLAS**
Professor of Economics, University of Chicago

I

THE chief aim of management and of production engineers is to increase the number of units of goods which can be produced with a given amount of capital and of labor. Along that line lie both greater profits to the producer and lower prices to the consumer. Up to a few years ago, such managers and engineers had an unfailing answer to all those critics who urged that by increasing the output per worker they were in effect reducing the number who needed to be employed and hence increasing unemployment. This was to assert that the lowered price of each article, which through competition would come in the wake of the improvement in production, would call forth such a great increase in the quantity demanded that in the end more workers would be needed in the industry than at the beginning. And to support this assertion, it was apparently only necessary to point to the experience of the preceding century. With every decade, manufacturing efficiency had increased and with it the numbers employed in the factories had also increased, not only absolutely but in proportion to the population as a whole.

It was, of course, true that in agriculture events were taking a different course. There, smaller improvements in efficiency than were occurring in manufacturing were nevertheless causing an even smaller proportion of the population to be employed. Whereas in 1870, 47 per cent of the working population were agriculturists, only slightly over 25 per cent were farmers in 1920. In other words, in 1920 it required but one man out of every four to feed the population, instead of the two who had been needed a half century before. But this was thought to be a unique situation which existed solely because of the fact that people's desires for additional food were rather sharply limited and fell off rapidly once a physical basis for life had been obtained. Such, it was thought, could not be the case in manufacturing for whose products, it was urged, there was a voracious and unappeased demand which would express itself in a great rush if only the prices of the commodities were reduced.

But during the last decade some very unfamiliar changes have been occurring. The output per worker in manufacturing, thanks to the moving assembly and to the teachings of Frederick W. Taylor, has increased by approximately 45 per cent. But to the surprise of most business men the number of workers employed in manufacturing has not only diminished relatively but absolutely. Before the business depression last fall there were approximately 900,000 or 10 per cent fewer wage-earners in our factories than there were ten years before. Nor is this phenomenon confined to manufacturing. Railway efficiency has risen, but the numbers employed there have fallen by approximately one-fifth or from around two million to about 1,600,000 workers. The output per worker has also increased very appreciably in the coal mines, but the number of miners has diminished by nearly 200,000. On every side, therefore, the question is being raised as to whether technical and managerial improvements do not after all cause unemployment, and the belief that they do is today one of the strongest obstacles to the program of rationalization in countries where, like England and Germany, the labor movement is strong. It is highly important, both for social and for business reasons, that technicians should face this question. It is to that end that this paper is devoted.

Now, it can be shown, as I believe I have demonstrated elsewhere and will try to prove briefly here, that improvements in production do not cause workers to be permanently unemployed,[2] but that in those cases where the demand is not sufficiently elastic workers who are displaced from their old jobs are likely to suffer a painful transitional period of unemployment before they are again placed. I can perhaps make this point clearer and indicate the types of cases in which a displacement of laborers will or will not occur if I choose a very simplified illustration.

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[1] Paper presented before a meeting of the Taylor Society, New York, December 5, 1930.

Let us assume that it requires one thousand workers from chopping the trees to writing the copy to turn out in a day 50,000 copies of a periodical which sells for ten cents. Then if the efficiency of each worker is doubled by approved Taylor methods, from fifty to one hundred copies, while day wages are retained, labor costs per piece will be halved. Now, let us assume (1) that labor costs are total costs and (2) that there is free competition in the publishing industry. The result will be that total costs will also be halved and the publishers, in their anxiety to get more purchasers for their paper, will reduce the price to five cents. At five cents, more copies will be purchased than at ten cents but the results so far as the displacement of labor is concerned will depend on *how many* more copies will be demanded. There are, in fact, three main sets of possibilities and only three. (1) The quantity demanded may increase in the same proportion as that by which individual efficiency increased and price fell. This the economist terms an elasticity of demand equal to unity. (2) The quantity demanded may increase by a proportion greater than that by which individual efficiency increased and price fell. This is an elasticity greater than unity. (3) The quantity demanded may increase by a proportion less than that by which individual output rose and price fell. This is an elasticity of demand of less than unity. Let us see what happens in each of these cases.

In the first case, the quantity demanded would now be 100,000 copies. Since the average daily output is now one hundred, there would still be one thousand workers needed and there would thus be neither an addition to nor a decrease in the permanent working force. If the quantity demanded were to double or more with this halving in price and if, let us say, 150,000 copies were now purchased, then 1500 workers would be needed and the industry would have to hire five hundred additional men. It is obvious that this was the experience of most manufacturing industries during the nineteenth century and of the automobile industry during the last twenty years.

In the third case, however, the new quantity demanded would be less than 100,000. If, let us say, 75,000 copies were purchased, only 750 workers would be needed in the industry and 250 men would in consequence be displaced.

These men would not, however, be permanently unemployed since there would now be spent daily only $3750 (i.e., 75,000 x $.05) for periodicals instead of the $5000 (i.e., 50,000 x $.10) which was spent before. This $1250 would now be spent on other industries, whether on commodities directly consumed or on those produced for future use, with the result that these other industries would ultimately need more labor. They would absorb a number equal to those displaced from the publishing industry since $5 would be transferred for every man displaced, the rate originally and still prevailing in the industry in question.

But the displaced workers would beyond question suffer an appreciable amount of temporary unemployment before they could find work in these other lines, and even then would tend to be in a worse situation because of their lack of trade skill. In industries, therefore, where the elasticity of demand is less than unity and where the flexibility of price is greater than unity we may expect, if other things remain equal, that an improvement in production will cause a displacement of labor. This is indeed the cause for the decline in the numbers employed in coal mining, on the railroads and in the more standardized branches of manufacturing. The demand for these commodities as well as for agricultural products now seems to have reached a point where it is in the main inelastic.

The above sketch of the theoretical nature of the problem has of necessity been incomplete. There are various other qualifications and amplifications which need to be added.

1. The smaller the trade division of the industry in which the improvement takes place, the greater will be the displacement of labor. The improvement in a few operations will not, except in rare cases, lower costs and prices sufficiently to cause a large enough increase in the quantity demanded to em-

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[2] "Technological Unemployment," *The American Federationist*, Vol. XXXVII, No. 8, August, 1930, p. 923.

ploy the same number of men in the improved processes. The same result will also occur where a plant producing a small part in an end product, such as the automobile supply factories, improves its efficiency.

To the extent, however, to which the price of the final article is lowered and demand increased, more men are needed in the other trades and divisions of the industry. With proper training the displaced workers may be at least partially absorbed in these other occupations.

2. The lower the ratio by which total costs are reduced as labor costs fall, the greater will be the temporary displacement of labor. The smaller the effect of increases of labor efficiency upon cost and price, the less will be the increase in the quantity demanded and therefore the greater the number of workers displaced.

3. The less business men reduce prices as costs fall, the greater is the displacement of labor. If they pocket part or all of the gain the increased profits which they receive will, when spent or saved, give increased employment for labor in other industries. But it will be a transfer of purchasing power which will take employment away from the industry in question. Similarly, if unit labor costs are not reduced commensurately with the increase in per capita output, prices will not be reduced and the quantity demanded will not increase as much as it otherwise would. The workers in an industry may, therefore, purchase higher money wages at the expense of displacing some of their members.

II

It is a logical consequence from all this that management should seriously concern itself with what is likely to be the effect upon employment of technical and managerial improvements. For truly good management will try to lessen the pains of the transitional period through which the displaced laborers will have to go, either by introducing technical changes as gradually as possible, by ceasing to hire workers for a time and thus allowing the working force to decrease through the natural process of attrition or by the payment of dismissal wages to those actually squeezed out. For all those purposes, therefore, it is important to know in advance what the probable displacement is likely to be.

It is also important for society to know what the probable tendencies will be so that it may give vocational advice to juveniles and adults and thus help to effect a gradual rather than a forced adjustment of the number of workers already in a given industry to the number demanded. Clearly, in order to be able to forecast these changes with any accuracy we must know: (1) the approximate technical and managerial improvements which are possible for the industry and (2) the approximate elasticity of demand for the commodity.

Since the first of these two variables differs from industry to industry and is so much a matter of technology, I do not consider myself competent to deal with it. Beyond remarking that for the last fifty years or so general production seems to have increased at an *average* rate of about 3 per cent a year, I shall pass over this phase of the question and devote myself to a consideration of how we may determine for a given commodity the second of these variables. I shall pause only to remark that the future prosperity of an industry is vitally bound up with the question of what its relative elasticity of demand is. The automobile industry has prospered in the past because the demand for its product has been highly elastic. This has operated to fill Flint, Detroit, Toledo and Akron to overflowing. On the other hand, the depressed state of the growers of cotton and wheat and of coal-mining communities is largely due to the fact that the demand for these products is relatively inelastic. An increase in production is accompanied by a more than corresponding fall in the unit price, with the result that a smaller total price is realized for a larger total volume. This means a lower than average return for labor and capital in these industries, and since labor and capital do not flow out of them automatically, a transitional period of suffering sets in. The devastating effects can be seen in the areas where these products are raised or mined.

Let us now turn to a consideration of the method and the formula by which we may measure the relative elasticity of demand. The common method of dividing the relative change in quantity by the relative change in price, or Marshall's formula of $\frac{dx}{x} \Big/ \frac{dy}{y}$ where x equals quantity demanded and y equals price per unit, is a purely static formula which assumes that there is no shift in demand, no change in the prices of other commodities and no change in their quantities. Very brilliant efforts have been made by Moore, Schultz, Lehfeldt and Ezekiel to derive from concrete historical data an approximation to the elasticities of demand for a number of commodities. Fundamentally, their methods have been two. One is to compute the relative changes in quantities demanded and in unit price for successive pairs of years and fit a line of regression by the method of least squares to these series of observations. The relative slope of this line of regression if price is taken as the independent variable will represent the elasticity of demand in relation to price while if quantity is taken as the independent variable the slope will represent the reciprocal of this or the flexibility of price in relation to quantity.

The other method is to fit a line of trend through the price quotations and a similar trend line through the quantities purchased. On the assumption that the factors other than the price-quantity relationship are contained within these trends, the ratios of the actual price and quantity quotations to their theoretical trend values for each year are then used to plot a series of observations. A line of regression is then fitted to these observations by the same method as that used in the case of link relatives.

Professor Schultz in his work has still further refined his computations by correcting his price data for changes in the general price level, and his statistics on quantities consumed by the growth of the population.

In my judgment, this type of measurement will be improved still further if we regard the change in the quantity of a commodity as consisting not only of the alteration in its own magnitude, i.e., more barrels of flour, tons of steel, etc., but also of the relative degree of this change as compared with that of production as a whole. I add this latter suggestion because of the fact that, if the production of a given commodity remains constant while that of other articles increases, then the price of this commodity will, in the absence of other disturbing factors, rise. This will be because it is now more scarce in relation to other commodities than it was before. The production of these other commodities furnishes indeed the demand for the commodity in question, and the greater this production the more intense is the demand for any product. Every wise manufacturer knows this and welcomes an increase in the production of all other industries (save those which produce articles which can be substituted), since this means more purchasers for his goods. The change in the value of a commodity is therefore affected not by a change in the quantity of that commodity alone but also by a change in the quantity of other goods and services. In order to isolate the effect upon real price, or unit value, of changes in the quantity of a commodity alone, it is necessary to express this change as a relative of the change in general production. This flexibility of value through time (which is the reciprocal of the relative elasticity of demand through time) may be expressed thus:

(1) Let m = Coefficient of the flexibility of value through time.
Y_1 = Relative exchange value of a unit of commodity "a" in year 1 as compared with year 0. ($Y_0 = 100$.)
X_1 = Relative quantity of commodity "a" in year 1 as compared with year 0 in terms of the relative change in the quantity of all goods and services. ($X_0 = 100$.)
q^1_0, q^1_1 = Absolute quantity of commodity "a" in years 0 and 1.
p^1_0, p^1_1 = Price per unit of commodity "a" in years 0 and 1.
P_0, P^1 = Index of general price level in years 0 and 1.
Q_0, Q_1 = Quantity of all goods and services in years 0 and 1, i.e., total national income in terms of dollars of constant purchasing power.
$\Sigma P_0 Q_0, \Sigma P_1 Q_1$ = Total sales prices of all commodities and services in years 0 and 1, i.e., total national income in dollars of current year.

Then

(2)

$$m = \frac{Y_1 - Y_0}{X_1 - X_0} \quad \text{or} \quad \frac{\log Y_1 - \log Y_0}{\log X_1 - \log X_0}$$

(3)

$$X_1 = \frac{q^1_1}{q^1_0} \Big/ \frac{Q_1}{Q_0}$$

(4a)

$$Y_1 = \frac{p^1_1}{p^1_0} \Big/ \frac{P_1}{P_0} \text{ or}$$

(4b)

$$Y_1 = \frac{\dfrac{p^1_1\, q^1_1}{\Sigma P_1\, Q_1}}{\dfrac{p^1_0\, q^1_0}{\Sigma P_0\, Q_0}} \Bigg/ \frac{\dfrac{q^1_1}{q^1_0}}{\dfrac{Q_1}{Q_0}}$$

In other words by equation (3) we find X_1, by dividing the relative change in the quantity of commodity "a" in these two years by the relative change in the quantity of all goods and services. Y_1, or the relative exchange value of a unit of commodity "a," may be found by two methods. The first is to divide the change in the price of a unit of commodity "a" by the change in the general price level. The second, which will give the same results if the index of the general price level is representative of all commodities and services, is to divide the relative change in the ratio of the total sales price of "a" (pq) to the national income (PQ) by the change in the quantity of "a" relative to the change in the quantity of all goods and services. This last or $\frac{q^1_1}{q^1_0} \Big/ \frac{Q_1}{Q_0}$ is of course the same formula as that for X_1. Then by dividing the relative change in the exchange value of a unit of "a" ($Y_1 - Y_0$) by the change in the quantity of "a" relative to the change in the quantity of all commodities ($X_1 - X_0$) we obtain "m" or the coefficient of the flexibility of value for this pair of years.

III

This method may perhaps be much more intelligible if we take a specific commodity, pork, and follow it through.

(1) The consumption of pork in 1927 (q^1_0) was 8122 and in 1928 (q^1_1) 8863 million pounds. The link relative for 1928 was therefore 109.12, using the 1927 quantity as 100.

(2) The price per pound in 1927 (p^1_0) was \$.179 and in 1928 (p^1_1) was \$.151.

(3) The total sales price of pork in 1927 ($p^1_0q^1_0$) was therefore 1453.8 millions of dollars, and in 1928 ($p^1_1q^1_1$) 1338.3 millions of dollars.

(4) The total national income in terms of dollars of the current year was 82,921 millions of dollars in 1927 (ΣP_0Q_0) and 84,119 millions of dollars in 1928[3] (ΣP_1Q_1).

(5) The total real national income, corrected for changes in the price level, in terms of 1913 dollars was 49,655 millions of dollars in 1927 (Q_0) and 50,692 millions of dollars in 1928[4] (Q_1). In terms of relatives, with 1927 as 100, the total real national income in 1928 would be the equivalent of 102.1.

We can now compute our coefficient of flexibility for this pair of years.

$$X_1 = \frac{8{,}863}{8{,}122} \Big/ \frac{50{,}692}{49{,}655} = \frac{109.12}{102.08} = 106.89$$

$$Y_1 = \frac{\dfrac{1{,}338.3}{84{,}119.0}}{\dfrac{1{,}453.8}{82{,}921.0}} \Bigg/ \frac{\dfrac{8{,}863}{8{,}122}}{\dfrac{50{,}692}{49{,}655}}$$

$$= \frac{.015910}{.017533} \Big/ \frac{109.12}{102.08}$$

$$= \frac{90.743}{106.891}$$

$$= 84.893$$

$$m = \frac{Y_1 - Y_0}{X_1 - X_0} = \frac{84.89 - 100}{106.89 - 100}$$

$$= \frac{-15.11}{+\ 6.89}$$

$$= -2.193$$

This indicated that in this pair of years a greater increase of 1 per cent in the quantity of pork than in the real national income was attended by a fall of 2.193 per cent in the real price or exchange value of a pound of pork. The elasticity of demand would be the reciprocal of this or .456. Similar coefficients have been worked out for each pair of years from 1909 on and are as follows:

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[3] King, W. I., *National Income and Its Purchasing Power*, New York, National Bureau of Economic Research, 1930, p. 74.

[4] *Ibid*, p. 77.

TABLE 1

COEFFICIENTS OF FLEXIBILITY OF VALUE THROUGH TIME OF PORK—1909-1928

PAIRED YEARS ENDING	COEFFICIENT OF FLEXIBILITY OF VALUE	PAIRED YEARS ENDING	COEFFICIENT OF FLEXIBILITY OF VALUE
1910	—1.703	1920	—2.547
1911	—2.098	1921	—2.785
1912	—1.809	1922	—2.483
1913	+50.761	1923	—5.693
1914	+1.648	1924	—10.377
1915	+1.965	1925	—5.020
1916	—3.624	1926	+1.587
1917	—2.157	1927	—14.889
1918	—.530	1928	—2.193
1919	—1.567		

While the results in some years are widely different, as for example 1913 and 1927 when the coefficients were respectively +50.761 and —14.889, there was in the other years a very appreciable degree of uniformity. In six of the nineteen years, the coefficient ranged between approximately 2.1 to 2.8; in nine years the range was between approximately 1.6 and 2.8 and the median coefficient was 2.157. By the use of logarithms the differences would be still further reduced. Taking the fifteen negative coefficients only, the median coefficient is —2.483 and the geometric mean —2.864.

A generalized expression can be found by fitting regression lines by the method of least squares to the link relatives of X and Y.

I am now attempting to measure in this manner the coefficients of flexibility for approximately one hundred and fifty commodities for the period 1909-1929.[5] In Table 2, I am presenting the preliminary results for nine of these commodities. Six of these are for meat products and hence for consumers' goods while the remaining three are for metals and hence for producers' goods. It will be noticed: (1) that the coefficients for the meat products are, as might be expected in the case of consumers' goods, negative and that their flexibilities of value through time, with the exceptions of mutton and lamb, are greater than unity; and (2) that the coefficients for the metals, or producers' goods, are on the other hand positive. An increase in value per unit is therefore accompanied by an increase in the relative quantity supplied rather than the reverse. This is on the surface a somewhat surprising result.

While a full generalization must of necessity wait upon the accumulation of more data, I should like to offer the tentative suggestion that if this positive inclination of the curve of the flexibilities of value of producers' goods holds true for other such commodities, we may have here both a result and a cause of business cycles. During the prosperity phase of the cycle the unit values of capital goods rise because their prices increase more rapidly than the general price level. But this is a period in which profit margins on turnover are in the main increasing due to the fact that goods purchased and fabricated at earlier and lower price levels are sold as finished commodities at later and higher price levels. For this reason, therefore, businesses tend to increase their purchases of raw material in order to take as much advantage as possible of this increase in monetary values during the process of manufacture. Thus far, therefore, the positive coefficients for producers' goods would seem to be the consequence of the business cycle. But the increase in consumers' goods ultimately resulting from this increase of producers' goods will, because of their negative flexibilities of value, have to be sold ultimately at lower price levels. The time movement now runs against business since raw material and labor purchased at earlier and higher price levels will have to be sold as finished commodities at later and lower price values. This shrinkage of monetary values in the process of manufacture greatly reduces the margin of profit on turnover and in some cases completely eliminates it. Business decreases its purchases of raw material and of producers' goods in the belief that it will be safer for it to purchase such material when prices have fallen still lower. But this slackening in the rate of purchase means also a slackening in the rate of production and of employment. With less employment, there is a smaller monetary demand for goods and this in turn decreases the volume of employment in trade and in manufacturing, with the result that relative purchasing power decreases still further. In this way, the processes of a business depression become cumulative.

Such a study of flexibilities may therefore throw

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[5] With the aid of Erika Schoenberg, Stanley Posner and Isabel Hall.

TABLE 2

COEFFICIENTS OF FLEXIBILITY OF VALUES FOR VARIOUS COMMODITIES

Year	Pork	Beef	Mutton and Lamb	Lard	Sheep Slaughter	Hogs Slaughter	Refined Copper (primary)	Zinc (primary)	Lead (primary)
1909									
1910	— 1.703	— .790		— 4.756	— 1.028	— .739	— 1.393	+ .072	— 3.986
1911	— 2.098	+ .970		+ 5.454	— 1.173	— .816	+ .341	+ .320	+ 1.601
1912	— 1.809	— 1.637		— 4.226	+14.124	— 1.301	+ 3.825	+ 1.392	+ .736
1913	+50.760	— .589		— .434	— 1.514	+32.020	— 4.239	+ 1.246	— .408
1914	+ 1.648	—12.451	+ .348	— .287	+11.623	+ .436	+ 1.296	— 3.007	— 1.300
1915	+ 1.965	+ .758	— .449	+ 7.357	— .804	— 1.124	+ .511	+10.075	— 1.650
1916	— 3.624	+ .383	— .357	+ 4.921	— 1.461	+ 7.089	+ 2.355	— .615	+27.967
1917	— 2.157	+ .743	— .506	— 2.857	— .895	— 1.754	+ 1.205	+ 3.790	+ 1.418
1918	— .530	+ .927	— 1.295	— .255	— .420	— .249	— 1.433	— 7.179	— 4.957
1919	— 1.567	— 2.030	— .345	— .486	— .891	— 1.298	+ .795	+ 1.211	+ 2.124
1920	— 2.547	— 2.617	+10.960	— 3.271	+ 1.745	+ 4.468	— .956	— 1.848	+ .864
1921	— 2.785	+ 2.834	— 1.789	+ 3.064	— 1.798	— 6.689	+ .478	+ .777	+ 2.226
1922	— 2.483	+ .181	— 1.360	+ .747	— 1.939	—16.360	+ .423	+ .432	—35.043
1923	— 5.693	— .486	+ .386	— 2.782	+ .323	— 1.913	+ .230	+ 1.891	+ 6.345
1924	—10.377	— 2.736	+ .502	— 8.259	+12.336	— 2.480	—17.818	+ 1.459	+ 7.993
1925	— 5.020	— 2.179	— 1.901	— 1.432	— 1.445	— 1.895	—17.250	+ 2.155	+ 1.401
1926	+ 1.587	+ 7.750	— 1.148	+22.387	— 3.387	— .026	+ .331	— .621	— 1.705
1927	—14.889	— 1.663	— .453	+ 6.868	+ .248	— 7.501	.301	+ 1.085	+ 1.471
1928	— 2.193	— 1.546	+ 1.195	— .710	+ 2.046	— .397			
N	(—) 15	(—) 11	(—) 10	(—) 12	(—) 12	(—) 15	(+) 12	(+) 13	(+) 11
Median	2.483	1.663	.827	2.107	1.309	1.3100	.495	1.246	1.601
Geom. Mean	2.864	1.714	.783	1.421	1.233	1.2767	.673	1.112	2.459

light upon business cycles as well as upon the laws of value, prices, and so forth.

While I do not wish to hold out false hopes, it is at least possible that these efforts when combined with those of other workers in the field may help to furnish business men and the public with tables showing the approximate flexibilities of value and elasticities of demand for most of the principal commodities. If and when this is done, business and social policy should be more intelligent, and economics may become less of an art and more of a science.

IV

We may perhaps admit this in a general way and still be somewhat uncertain as to the precise light which will be thrown upon the problems of industrial displacement. Whether an industry is prospering as compared with its fellow will depend upon a double relationship: (1) the relationship between the *rate of change* in the physical production of each commodity and the *rate of change* in the production of all commodities and services, and (2) the relationship between the relative flexibilities of value of each commodity and the average flexibility of value for all commodities. This average would seem on *a priori* grounds to be unity or 1.0, and one of the by-products of the investigation which I am carrying on is to determine as closely as possible what this average is. A fair generalized statement of what these results are likely to be is:

1. If the flexibility of value through time of the commodity is itself approximately unity, then it will continue to obtain approximately the same slice of the national income and there will be little relative displacement of labor. The industry will hold its own with little growth (aside from that furnished by the general expansion of industry) and with little decay.

2. If the flexibility of value through time is greater than unity then the following results may occur.

a. If the increase in the physical productivity of the commodity is greater than the increase in all commodities (or in the case of a decrease, if it is less) the fall in unit values will be greater than the relative increase in physical quantities, and the total fraction of the national income which the commodity forms will diminish. The annual income of the workers in the industry will fall, therefore, in relation to the general average of workers, and labor will flow out of the industry. Similarly the rate of return to capital will be lower than in industry as a whole and the capital investment will slowly diminish.

b. If the rate of change in the physical product is approximately the same as that for all commodities, then there will still be a fall in the unit values of the commodity because these added units of goods will appear at a lower point on the demand curve than is the case with the average for other commodities. The result will be a fall in the share of the national income possessed by this commodity and consequently a transfer of labor and of capital.

c. If the rate of increase is less than that for all commodities (or in the case of a decrease, if it is greater), then the unit values of the commodity will increase. If the flexibility is greater than unity in the case of relative decreases in quantity as well as in relative increases,[6] then this rise in unit values will more than offset the greater relative scantiness of the product. The result will be a larger share of the national income and a flow of labor and capital toward the industry in question, until the balance is re-established.

3. If, however, the flexibility of value through time is less than unity, then the following results may occur.

a. If the rate of increase in the physical quantity of a commodity is greater than the average, the fall in unit value will not be enough to compensate for this greater increase in quantity, with the result that the share which it forms of the national income will increase. The relative amount of capital invested in the industry will therefore increase as will the numbers employed. This—added to the increasing delight of the American people in open-air locomotion—has been a reason for the increase in the numbers employed in the automobile and rubber industries.

b. If the rate of change in the production of the commodity is approximately equal to that of all commodities, then there will be a tendency for the unit value of the commodity to rise, and therefore for more labor and capital to come into the industry.

c. If, on the other hand, the rate of increase in the quantity of the commodity is less than that of all commodities (or in the case of a decrease, if it is greater) then the rise in unit values will not be enough (assuming the flexibility is the same when there is a relative decrease as when there is a relative increase) to offset the relative decline in quantity, and as a result the commodity will form a smaller share of the national income. There will thus be a displacement of labor and an outward flow of capital.

While we shall know much more about these problems when we have charted our rates of growth and computed our flexibilities of value, this analysis should help us to make some predictions as to the future course of some industries. Wheat, cotton and coal all seem to have relatively high flexibilities of value, and great improvements in production are now taking place in all three. I think it is safe, therefore, to predict that their long-run prices will continue to fall relative to the general price level by amounts which will more than offset their increase in production. I am inclined to believe, therefore, that the displacement of labor which is now taking place on a considerable scale in these industries will continue and that, in consequence, we may expect a continuation of the migration from the farms to the cities. I am inclined to believe that the same will hold true in the case of corn, etc. On the other hand, we may expect a continued growth in the numbers employed in the services, the demand for which seems to be very elastic.

Discussion

Elizabeth F. Baker.[7] Professor Douglas, as usual, has given us two years' instead of two hours' worth of food for thinking. His statistical courage never fails to be heartening. We who struggle among details get a sense of seeing a deliverer sail along on a magic carpet to light on firm ground beyond us, where troubles such as ours do not exist.

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[6] This may not be so.

[7] Assistant Professor of Economics, Barnard College, New York, N. Y.

In the direction of analyzing the problem of the displacement of workers by technical advance, a matter about which we know all too little as yet, the speaker asks two questions: (1) How much is it possible to increase the output of, say, 150 commodities, i.e., what mechanical and managerial progress can be made, and with what effects upon output? (2) What are the probabilities that the increased output will be absorbed at a unit price no lower than that commensurate with decreased unit costs of production?

The reasoning is, with qualifications, that insofar as added output can be sold at a price no lower than the decrease in unit costs (where elasticity of demand is at unity or above) there will be no resulting displacement of men. On the other hand, insofar as selling price must be lowered beyond the saving in unit cost in order to market the increased product, there will be displacement of men. Here industry will contract, as agriculture has been doing, and possibly disappear as the manufacture of stage coaches has done, while in the former case the industries will expand, as automobiles, rubber goods and the services have done. The reasoning continues that, if we can discover that these industrial changes are taking place —contraction on the one hand and constancy or expansion on the other—then we can with reasonable security warn and educate workers away from some industries and toward others.

There are two points of inquiry which I should like to raise just here in passing. (1) Has foreign demand for American products been implied in the discussion of effective demand, and if not, will it not have to be included in calculating the rate of contraction or expansion of an industry? For example, what is the ratio of pork exports to total production of pork? (2) If foreign demand is to be included in the calculations of flexibility, how can trends be corrected for the uncertain effects of our Grundy tariffs, and for shifts in the payment of war debts and reparations?

These points bring me to another parenthetical question. Must not the reasoning in regard to the displacement and reabsorption of workers apply to world instead of national employment, If the saving in labor expense in the publishing industry in this country was spent for carved ivory toys made in China, then the displaced men in the United States would not soon be re-employed by the investment of that money. Some Chinese people presumably would receive employment. Or, when profits are applied to archeological research in Egypt, employment is provided there and not here.

To proceed with the main discussion, let us grant the methods employed and suppose that Professor Douglas' two major variables needed for his forecast of the displacement of workers have been computed: (1) the approximate technical and managerial improvements which are possible for the industry; (2) the approximate elasticity of demand for the commodity. Let us say that we have on the left a list of possible outputs of 150 commodities and the cost of producing them; on the right, the prices at which these outputs will sell. While the figures discourage the production of farm products as a whole, they encourage corn more than wheat, let us say, and beef more than sheep; while they discourage standard branches of manufacturing, they encourage automobile and rubber production; while they encourage cinemas, they discourage orchestras.

Here would seem to be information that would help us draw up a five-year Gosplan. But will there not be important difficulties in the way of their use in our own planless society? Unit costs calculated under high standards of production would not apply to the high-cost producers who waste labor and capital. These are always with us. While it is true that under perfect competition these high-cost producers would be forced out of the industry or else into line, we do not have perfect competition. We are becoming less competitive rather than more.

If, on the other hand, our disappearing competition should develop into some great control system of production, then two columns of calculations such as these would be immensely useful as a guide, even though they were based upon data gathered in a planless society where price has so much influence upon supply.

But I see further difficulty in the application of Professor Douglas' procedure to the problems of technological unemployment. While 150, and more, commodities can doubtless be analyzed in the way he proposes, there are other important commodities that, under present conditions, cannot be so analyzed. I have in mind, for example, the products of the commercial printing industry.

Commercial, or book and job, printing is an important branch of the printing and publishing industry, the last step in the long line of operations from tree felling to the writing of copy. There are three distinct and separate departments in commercial printing—the composing room, the press room and the bindery. In order to analyze for forecasting purposes, as has been proposed, the technical advance and resulting demand upon the employment of workers in commercial printing, it would be necessary to take each of these departments separately. This is because the *nature* of the product determines the relative amount of work to be done in each of these departments. For instance, a greater output of large circulation magazines would require relatively less employment in the composing room, less in the make-ready performance in the press room, but more operation of presses and more bindery work. Whereas increased production of high-grade, short-run printing (of illustrated brochures, of theatre, dance and dinner programs and the like) would increase employment in the composing room and in the make-ready performance of the press room, relatively less time would go into the running of presses and the bindery operations. The transfer of workers from one department to another would be impossible in most cases, even if there were no unions to prevent it, because of the high degree of craftsmanship required.

It is because of the wide variation in the nature of the product in commercial printing that one cannot wring from an employing printer or from his books a statement of commodity output this year as compared with last, of unit costs, or of price to the customer. If a customer has his work done in the third week of the month instead of the first, let us say, he may receive a 25 per cent lower price quotation; or if he orders the printing of two thousand six by eight sheets he might pay more per thousand than for ten thousand ten by twelve sheets, *unless* a half tone or colored illustration or two were printed on the ten thousand sheets, or unless the paper was very thin or uneven in thickness. High-grade work on ten thousand sheets would probably cost more per thousand than inferior work on two thousand sheets.

Thus an index of production has not yet been evolved for book and job printing. Yet here has unquestionably been an expanding industry. According to the census the corrected dollar value added by manufacture increased 108 per cent from 1914 to 1927. But this gives no clue as to changes in the nature of the product. The census also shows a 25 per cent increase in the number of workers employed, but this indicates nothing of the demand for linotype men as compared with pressmen, nor of the demand for press feeders and assistants.

It has been possible to indicate roughly the increased demand for press-room work by showing the derived demand for presses as seen in the sales figures submitted by press manufacturers for the thirteen-year period from 1914 to 1927. This increase was 78 per cent. Attempts to measure the increased output of these presses were reduced to a theoretical rather than an actual calculation of the hourly rate of output. The aggregate *square inch capacity* per hour of the accumulated presses was computed by taking the average number of impressions they printed per hour on the *average* grade of work. The increase in this square-inch capacity per hour in 1927 as compared with 1914 was 98 per cent (somewhat lower than the 108 per cent increase in value added by manufacture for the industry as a whole, after an unknown number of presses had been discarded).

These standard averages have been computed for the United Typothetae of America and are probably as near an approach to actual press production as can be made. Many printers say, however, that they are too low. For instance, I stepped into a medium-sized press room one day and saw printed sheets coming out over the gas flame of a hand-fed cylinder press at the rate of 1,500 an hour where the average figure which I had taken for that group of presses was 960.

So, while every calculation corroborates the report that the demand for commercial printing has gone up, the fact that we can measure neither output nor price trend would render us helpless in discovering the coefficient of flexibility and its reciprocal, the elasticity of demand.

It has been necessary to proceed quite differently in the attempt to observe the process of displacement of workers by technical change in the press room of this industry. (Change in recent years has been greatest in the press room.) To draw close to the actual situation it was necessary to study a selected number of plants over a period of years, noting exact changes in equipment and in the employment of men — how many and what men were transferred to the new processes, what men were thrown out and why. I have hopes that studies of this kind may yield results that are also useful in redirecting workers whose security, if not their immediate jobs, is affected by changing technology.

So, in conclusion (true to the instinct of self-preservation), I submit that while we must have this strong but diffused light which Professor Douglas brings to solve the problems of technological unemployment, we also need, in order to complete the task, small high-voltage lamps fixed at close range upon the nooks and crannies of industry.

Sumner H. Slichter.[*] I shall spend most of my time discussing several aspects of technological unemployment, but I wish to make a few preliminary remarks in regard to Professor Douglas' method of measuring the elasticity of demand.

The change which he proposes is a simple one and easy to understand. The elasticity of demand has ordinarily been conceived as a relationship between price changes and the quantity of the goods which is purchased. In place of the comparison between these two quantities, Professor Douglas proposes to examine the relationship between the exchange value (relative price) of a commodity and the relative quantity of the commodity that is purchased.

The usefulness of the proposed method of measuring the elasticity of demand depends upon whether it has greater prediction value than other methods. In other words, is there a more regular and consistent relationship between exchange values and relative quantities purchased than between prices and actual quantities purchased? This is a question which can be answered quite readily by computing elasticity in several ways. Consequently, I hope that Professor Douglas will compute elasticities by one or more of the other methods and compare the results with those produced by the method which he proposes.

My own conviction is that Professor Douglas' formula probably does not possess as great prediction value as do several other formulae. For this belief there are three principal reasons. In the first place, it would not be logical to expect a very constant relationship between the exchange value and the relative quantity of a commodity that is sold. Economists distinguish between competitive goods and complementary goods. Goods that directly compete with one another are, of course, competitive goods; goods that are used together are complementary goods. A change in the relative quantity of a good might be produced by changes in the output of (1) competitive goods or (2) complementary goods. And yet the effect upon the exchange value of the good would be exactly the opposite in the two cases.

A second reason for doubting the prediction value of the formula rests, not in the logic of its construction, but in the nature of the data which its use requires. It demands the use of many items for which no reliable figures are obtainable. Professor Douglas derives the exchange value by dividing an index of the price of the commodity by an index of the general price level. But no satisfactory index of the general price level exists—no index, for example, which includes such important items as rent, wages, or transportation rates. Having obtained two unreliable exchange values (one for each of the two years which are being compared) Professor Douglas divides one into the other. In order to compute the relative quantity of the commodity purchased, Professor Douglas must deflate the estimated national income for each year in the comparison. No satisfactory figure for the national income exists and the deflation must be accomplished by the use of the unsatisfactory index of the general price level. There are several additional divisions in which these necessarily unreliable results are divided into each other. In fact, an examination of the formula shows that there are no less than four divisions in which the uncertain general price level is the divisor, two in which the uncertain national income is the dividend, and three in which these unreliable results are divided into each other. This pyramiding of the division of one uncertain quantity into another uncertain quantity is likely to magnify errors. It is not surprising that for the last seven years Professor Douglas' results for the flexibility of the price of pork exhibit little regularity: -2.5; -5.7; -10.4; -5.0; +1.6; -14.9; -2.2.

In the third place, the prediction value of the method is restricted by the fact that it expresses elasticity in terms of exchange value rather than price. Exchange value is likely to be more difficult to forecast than price because it requires, in addition to a forecast of the price of the given commodity, a forecast of the general price level.

But let us pass on to a brief discussion of several aspects of the problem of technological unemployment. Is there more technological unemployment today than formerly? No one knows. In an attempt to answer the question, I have computed the unemployment rate for selected periods during the last thirty years, avoiding years of pronounced depression when the volume of cyclical unemployment was large. I have used the best estimates that are available, namely, those of Douglas for the period before 1920, and those of Givens and Wolman for the years subsequent to 1920. The average unemployment in manufacturing, transportation, building and mining for selected periods was as follows:

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[*] Professor of Business Economics, Graduate School of Business Administration, Harvard University, Cambridge, Mass.

1900 to 1907 inclusive......7.6 per cent
1909 to 1913 inclusive......8.1 per cent
1916 to 1920 inclusive......6.2 per cent
1923 to 1926 inclusive......9.1 per cent

Apparently there has been a moderate secular increase in unemployment. But, in view of the approximate character of the estimates of unemployment, too much importance must not be attached to this apparent increase. Certainly the increase is scarcely sufficient to explain the great discussion which technological unemployment has provoked. This discussion has been due, I think, largely to the kind of people who are unemployed and the kind of unemployment which they have suffered. The men who have lost their jobs because of labor-saving methods and geographical shifts in industry have been men who have found it exceedingly difficult to obtain other work. They have been the older and the less desirable employes. Once crowded out, they have found it exceedingly difficult to obtain steady work again. The investigations of Lubin, Clague and Myers show this conclusively. Although the relative amount of unemployment has not been much greater than before the war, it has been more painful and serious to the individual.

Professor Douglas has suggested that displacement of labor is not likely to occur in industries which produce commodities that are elastic in demand. In some cases this may be true but in many (I suspect the majority) it is not. Why? For one reason, the labor-saving changes always precede the price changes. The price changes, even though they ultimately may be great, occur very gradually. A few plants in the industry put in a labor-saving method. They are not anxious to cut prices. They are anxious to keep the profit of the labor-saving method for themselves. They cut prices only enough to keep busy. In the meantime, however, they get rid of a number of men. Possibly that process goes on for a number of years. More and more plants put in the labor-saving device. Men are displaced. The price gradually goes down, but the price adjustment always lags behind the technological change. The men who have been released—the older and the less desirable men—are not necessarily taken back by the industry when it finally begins to absorb labor. The industry competes with every other industry to get the cream of the men in the labor market, and the employes who have been crowded out by labor-saving methods are not hired by any industry until younger and more desirable men are not available.

Another reason why serious technological unemployment may accompany an elastic demand is because technological changes alter the occupational demands of the industry. The introduction of the molding machine may destroy the demand of an industry for skilled molders. It may also reduce the price of the product, increase the sales, and lead the industry greatly to increase its force of machinists. But as far as the displaced molders are concerned, the demand for labor might just as well be in some entirely different industry—as it would be in case the demand for the product were inelastic rather than elastic.

Technological unemployment may be aggravated by the fact that the process of introducing labor-saving devices is often a cumulative one, especially in periods of falling prices. One industry is enabled by a labor-saving invention to cut the price of its product. Other industries, which make products that more or less compete, find their markets shrinking. In order to keep up their sales, they must cut their prices too. Consequently managers are stimulated to discover ways of increasing efficiency and cutting costs. This spreads from industry to industry. The result is that men may be displaced by labor-saving methods faster than they are absorbed by the growth of industry. This situation is less likely to occur in periods of rising prices because rising prices are a sort of subsidy to everyone in business. Consequently, when prices are advancing, managers do not feel such a compelling necessity to cut their costs. In a period of falling prices, however, the pressure on managements to preserve profits by cutting costs is doubly strong and the displacement of men is likely to exceed the power of industry to absorb them at existing wage rates. This, I believe, has been the situation in American industry during the last eight or nine years.

I wish to close with a constructive suggestion. There are about 200,000 manufacturers in the United States. It is an elementary principle of management and of politics that, in order to get things done, responsibility must be definite and concentrated. It would be folly to expect the 200,000 manufacturers to shoulder the responsibility for dealing with technological unemployment. If we really wish action, we must give someone the definite task of doing what can be done. The problem is largely one of reducing the displacement among the older and the less desirable employes and of concentrating the effect of industrial changes upon younger workers who can be more easily placed in other employment at existing wage rates. It is obvious, therefore, that progress in dealing with technological unemployment requires a well-organized labor market—in fact, no kind of unemployment would be reduced so much by better organization of the labor market. Unfortunately most organizations of manufacturers in the United States have shown no disposition to help improve the organization of the labor market, and—I cannot make this too emphatic—have actually fought, in the states and in Congress, such efforts as have been made to create modern machinery for marketing labor. This opposition of manufacturers to modern machinery for marketing labor is just as uneconomic as the opposition of some wage earners to modern machinery in the work shop.

To provide leadership in dealing with technological unemployment, I suggest a Federal Labor Board composed of six or seven industrialists and labor leaders with the Secretary of Commerce and the Secretary of Labor ex-officio members. The Board would be provided with a technical staff and connected with industry by a national advisory committee and by regional and industrial advisory committees. The federal employment exchanges would be transferred to the Board's control and the Board would be provided with funds for expanding the services.

What could the Board do about technological unemployment? As soon as it became apparent that a new machine would displace labor on a substantial scale, that machine should be the subject of immediate study by the technical staff of the Board. How many men is the machine likely to displace and how rapidly? How can the influx of young workers into the shrinking occupation be promptly stopped? How can employers who need men in the occupation obtain them from other enterprises which are installing machines and laying off men? Into what other pursuits can the displaced men be most advantageously transferred? The technical staff should prepare a definite plan for meeting the problem created by the machine. This plan should be submitted by the staff to the Board and by the Board, in turn, to the industry. After receiving criticisms and suggestions from the industry, the Board should work out a revised plan which it should ask the industry to accept. Obviously the Board would have no power to compel acceptance of its plans. Its effectiveness would depend upon its success in commanding voluntary co-operation. This, of course, would depend upon the reasonableness of the Board's suggestions and the respect which the members of the Board, by virtue of their ability and fairness, would be able to command.

In conclusion, permit me to suggest that such a Board would represent scientific management applied to the marketing of labor. There is just as much need for careful planning to adjust the movement of labor to the ever-changing needs of industry as there is need for scheduling and planning to assure a smooth and unbroken flow of material through a shop. I hope that at some future meeting the Taylor Society may devote a session to the specific topic: "Scientific Management of the Marketing of Labor."

Leonard Kuvin.[9] Technological unemployment is that fraction of total unemployment which may be ascribed to the displacement of men by machines. Because such displacement has been brought about generally without the accompaniment of other economic changes which would transform into cultivated leisure what is now devastating and demoralizing enforced idleness, the entire phenomenon of displacement is viewed as, on the whole, unwelcome. The engineer has done very much to bring this state of mechanization about; the economist and the public at large would like to see its immediate and its long-term effects dealt with properly.

We all know that this condition is not a new one. Mechanization of industry has been part of the natural order of events since the industrial revolution. The difference between conditions today and what they were years ago is that whereas labor at one time resisted the introduction of the machine, now the machine is resisting in a different manner the utilization of labor.

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[9] Secretary of the Statisticians in Industry, National Industrial Conference Board, New York, N. Y.

The days of business recession are the days when constructive measures may be thought out at least, if not immediately adopted. The very phenomenon of expansion and mechanization of industry is more steadily being accepted as an underlying condition which if improperly dealt with leads to periodic business recessions. The need immediately before us is to diagnose the condition and to suggest, if possible, the means of cure.

Professor Douglas has in his study isolated the phenomenon of changes in price in their relation to changes in demand. His mathematical attack, if properly extended beyond the necessary closed system involved in a two dimensional projection of a three dimensional continuum of price, quantity and time, may point the way.

A comprehensive analysis would have to embody interaction of commodities in domestic and foreign markets as well as elements of changed economic institutions and affected human behavior. When such an analysis is completed we shall be well on the road toward the solution of all economic problems in an economy of profit and competition.

The essence of the solution, it seems, would be the discovery of the truth in factual form, and the dissemination of knowledge for purposes of better individual and collective planning and control.

To this end considerable cold light could be thrown on matters if to the knowledge of static reactions of supply, demand and price were added the available factual material on the growth of industries in time. We know that in this country the railroads had their era of rapid expansion; at another time copper mining took the lead; at another steel production; at another radio and at still another aviation. In each of these cases and in any number of others, the industry goes through a period of rapid growth and expansion and then assumes a diminished pace and tempo.

Invention is followed by engineering application, manufacture and distribution. When technological developments reach a point where the product receives general utilization under economic conditions prevailing at the time, the industry takes on a retarded rate of growth more closely in line with the growth in population than before. The demand for a particular item under consideration is either elastic or inelastic depending upon both the stage of technological development possible in the industry and the consuming power of the particular portion of the population capable of being served by it. A commodity which can be produced so cheaply as to be within the reach and a part of ordinary prevalent living standards of the bulk of the population tends to become inelastic in its demand qualities; the opposite also holds true.

No elaborate statistical verification need be summoned to substantiate these facts of retarded growth of industries, though there is an abundance of data easily at hand. The points to be emphasized are that retardation depends on both technical processes and on possible distribution of the product to the consuming population. But it must be recognized that the growth of complimentary industries, the capital available for them and the fact of lack of synchronism in the growth of all industries have also major retarding influences. They all work together to bring about at one or another time a period of readjustment. They induce directly and indirectly the displacement of labor known as technological unemployment.

We are prone, however, to focus our attention on the short-term run of forces. This is chiefly because the effects of technical change, especially in mechanization, are relatively quickly observed in the displacement of labor. Data on changes in the past decade show clearly, moreover, both the lack of uniformity of industrial development in production and the disproportion between the growth in production, the growth or decline in payrolls and the growth or decline in employment.

The five-year period between 1925 and 1929, inclusive, when compared with the five year period 1920 to 1924 discloses interesting relationships. Federal Reserve Board indexes for all industries showed a gain of 26 per cent in production against a 9 per cent gain in payrolls and a 4 per cent gain in employment.

In the non-ferrous metal industries there was a 50 per cent gain in production as compared with a 10 per cent gain in payrolls and a 1 per cent gain in employment. In the iron and steel industry there was a 36 per cent gain in production as compared with a 13 per cent gain in payrolls and a 7 per cent gain in employment. Textiles gained 17 per cent in production, 2 per cent in payrolls and showed practically no change in the employment of labor. In automobiles there was a 13 per cent growth in production, a 38 per cent gain in payrolls and a 28 per cent growth in employment. This industry reacted best from the standpoint of balanced growth, payrolls and employment. The food, leather and tobacco industries showed decreased employment with increased production.

Changes in production and employment check fairly closely with comparable statistical data on the horsepower installed, wages paid and wage earners engaged as reported in the Biennial Census of Manufactures. Suffice it to say that the total of primary horsepower installed for all industries gained 24 per cent when 1927 was compared with the average of years between 1919 and 1923; wages gained 10 per cent while the number of wage earners increased 1 per cent.

These are rough but accurate recent indications of (1) the lack of uniformity in technical growths of industries; (2) the lag in wage income under the growth of physical volume of production with the consequent slack in consuming power; and (3) the displacement of human labor power by electrical machine power.

This last displacement is being brought about with the greater flow of capital into industry and its substitution for labor. Precisely how much capital, labor and management should be combined to effect a proper combination of forces is another of the unsolved problems of economics. Here again Professor Douglas has in a previous study essayed the task and here again has been obliged to isolate a segment of the complex of variables that enter into the problem. The particular mathematical methods employed may, if extended and perfected, in the course of time, point the way to solution.

Interesting and illuminating data of the volume of new funds obtained by security issues in recent years are becoming available. New money flowing into productive and operating enterprises, old and new, amounted to 2414 millions of dollars in 1924. They grew to 6141 millions of dollars in 1929. Between 1924 and 1925 the increase was 13 per cent annually. But between the first half of 1928 and the first half of 1929 the rate of growth bounded to 63 per cent. This amazing rate of change could tell a story if detailed information were investigated.

If funds raised for capital purposes were put immediately to work to expand industry, as they were intended, we probably would have postponed the current period of depression into the future. Men would have been engaged in new or expanded industries. We would probably now be enjoying an interval of prosperity until we got to the point where the market became unable to absorb the commodities prepared for the consuming population. The situation is one of a lagging standard of living.

Under our present condition of productive overcapacity we can not only raise our own high standard of living but export commodities and capital and raise the standards of living abroad. But national and political barriers intervene and economic science offers at present but a timid academic voice in protest.

Aside from the necessarily slow processes of educating and attempting to obtain agreement on analyses, ideas and doctrines, what is there that can be done to put the economic machine in order and prevent periodic depressions, and that one element known as technological unemployment? The two are interwoven and cannot be treated separately if a genuine solution is to be effected.

We virtually know what ought to be done. First, production should be planned and controlled. Particular and general expansion should be regulated and guided. Second, the standard of living should grow apace with growth in productive capacity. The consuming power of the underlying population should be permitted to develop so as to clear the market of commodities at its disposal.

A stable general price level is not enough to insure against trouble. True enough, it would prevent dislocation in industry; it would obviate the shift of obligations between debtors and creditors. But most of all, and this fact is not stressed by the stabilizing school, a steady price level would support the planning element, a purposive element in national and international economy.

Assuming that agreement among men and mice is possible and attainable, what can be done to hang the bell on the cat? We must recognize the virtues as well as the defects of the system of profit making and competition and lay out our program accordingly.

The engineer and the economist can and should pool their abilities in a common effort. The engineer, who now views industrial mechanization as the monster which he nurtured and which in turn is causing him to lose his job, can direct his energies into constructive channels.

Let him turn economist and statistician in industry. He can measure the present productive over-capacity of his industry in terms of idle machine hours, the per cent of actual output to potential output. He can advise his employer on the rate of introduction of new equipment and of the possibilities of using the productive capacity standing idle in the most prosperous of times. The consuming public pays for this idleness in that element of price which is generally termed overhead, interest on investment, fixed charges and burden.

The economist and the engineer can forecast prospective sales, regularize activity and employment, and in their humble way add to the rationalization of business.

A major controlling force could be instituted in our national economy if a national advisory board of engineers, economists, financiers and business men were created to work in conjunction with our governmental and financial institutions to recommend and assist in putting into effect a program that would delay funds from flowing into some industries and assist the flow into others.

At present the extended purchase of government bonds by the Federal Reserve Banks, ardently advocated in some quarters as a method for lifting us out of the business recession by the route which will put more credit into the market, increase the price of industrial bonds, facilitate new issues and raise the commodity price level, is an indiscriminate one. It is more than likely that industry has sufficient capacity to proceed with. True enough, a start in expansion would help, but it would only pave the way for the next recession as previously pointed out. It would constitute a further installation of the new "make work" fallacy in industry.

At the present time the rediscount rate of the Federal Reserve System is regulated geographically. But ways and means can be devised for varying the rates industrially, a difficult thing to do, to be sure, but perhaps a good thing. With effective methods for industrial co-operation established, it is one very possible to achieve.

Concluding as we began, technological unemployment is part of the entire phenomenon of general periodic unemployment and is perhaps closest to the heart of the matter because mechanization of industry is closest. Its cure may well be effected by the cure of periodic general unemployment and business recession.

Mr. Kendall. I am interested in the principle presented here this morning and should like to ask the speaker whether or not he considers it applicable to manufactured products as well as to the raw material commodities he has used? More specifically, would it be applicable to cotton textiles as well as to cotton?

Mr. Douglas. I think there is a very real relationship between the flexibility of value of end products and their raw materials. The thing is, of course, somewhat complicated by the fact that many raw materials have several end products whose prices may not all move in the same direction at the same time, and by the fact that the nearer you get to the consumer the more differentiated and unstandardized the product becomes, and therefore the more difficult to measure. I am convinced, however, that the relationship does exist between the flexibility of value of consumers' goods and their raw materials. I am not so sure about producers' goods. As I have hinted, we may have one of the causes of the business cycle right there.

Mr. Leffler. I get the impression from your paper that it is based on an assumption of a more or less static society that is willing to spend the same proportion of its funds on the same things in 1928 as in 1909? Should not your figures take into account shifts in the demand curve as well as the different points on it?

Mr. Douglas. What you say would be true if I were comparing 1909 with 1928. But you will notice that I am comparing pairs of years, 1909-1910, 1910-1911, etc., and this reduces changes in the demand curve. Changes such as the substitution of rayon for cotton, increased use of copper due to public utilities' consumption, etc., are not marked in year to year comparisons. I should like to reduce the periods still further—even to months—but have not been able to do so thus far. I believe the formula can be used for short-term predictions because there is a certain regularity in life which enables us to assume that the past will repeat itself to a certain extent. There will, of course, be unpredictable changes in techniques and desires in the distant future.

Mr. Leffler. I hold Professor Douglas' scheme to be most ingenious and valuable, but I do feel the problem of technological unemployment to be of such importance that any prediction scheme should hold for more than one or two years in the future.

Mr. Kendall. Technological unemployment has been defined as that unemployment resulting from labor-saving devices. I believe it has a broader meaning than that. I question whether there is any difference between the man thrown out of work because of the introduction of a labor-saving machine and the one thrown out of work because of improvements in management technique and because of the combinations taking place right along in industry. The force of competition of one industry against another—rayon against cotton—and of one machine against another—the Diesel engine against the steam engine—is compelling improved efficiency of management which is cutting down labor forces. It seems to me that this tendency is being accelerated at the present time and that the number of people employed per unit of production is going to decrease continuously. Therefore this question is a tremendously serious one, especially so since these displaced people are not the down-and-outers and the inefficient. I for one do not see the remedy and it is the remedy that we need. I had hoped that the papers and discussion this morning might take hold a little more firmly of that problem. We have to know trends and their scientific and mathematical basis but these are useful only if they point out a remedy.

Annual Business Meeting

THE Annual Business Meeting of the Taylor Society was called to order at four o'clock, December 4, 1930, in the Small Ball Room of the Hotel Pennsylvania, New York. The meeting was opened by President Kendall and the presence of a forum recorded. Reading of the minutes of the previous meeting was waived. The report of the Treasurer was received, placed on file and mimeographed copies distributed among those present at the meeting. The Managing Director then made an informal statement concerning the work and problems of the Society. It was voted that the Managing Director send Mrs. Frederick W. Taylor, about to sail for Europe that evening, a message of grateful appreciation for her generous interest in the work of the Society.

The committee which had opened and counted letter ballots for the election of officers reported the result of the election as follows:

Officers

President and Director (1 year): Henry P. Kendall, President, The Kendall Company, Boston.

Vice President and Director (2 years): Arthur T. Davenport, General Manager, Sweet-Orr & Company, New York.

Treasurer and Director (1 year): Edward W. Clark, 3rd, E. W. Clark & Company, Philadelphia.

Directors (2 years): Francis Goodell, Naumkeag Steam Cotton Company, Salem Mass.; Hudson B. Hastings, Yale University, New Haven, Conn.; H. S. Person, Taylor Society, New York.

Nominating Committee

The following were selected as a Nominating Committee for the ensuing year:

Ernest G. Brown, Bristol, R. I.; T. C. Eckstein, Chicago, Ill.; B. Eugenia Lies, New York; A. B. Rich, Framingham, Mass.; N. I. Stone (Chairman) New York.

Maintenance of Standards[1]

Some Conclusions Concerning Maintenance Practices Based on a Number of Plant Inspections

By VICTOR S. KARABASZ
Professor of Industry, University of Pennsylvania

THE utilization of the scientific method in the solution of business problems is relied upon by every modern manager. All pertinent facts with reference to the specific business situation under consideration are gathered, classified and evaluated, and upon this study a decision is made, rather than upon mere guess or opinion. We live in an age where fact is rapidly supplanting opinion, where careful study, investigation and research are replacing rule-of-thumb methods. In a business, therefore, which is in tune with this age of fact and research standards must necessarily be developed, because standards are the result of careful investigation and research.

A study of the works of Frederick W. Taylor will show the tremendous importance which he placed upon the establishment of standards, and even a casual study of the BULLETIN OF THE TAYLOR SOCIETY, from the earliest days of its publication, will indicate that this basic management step has been among the subjects receiving most attention.[2] Further evidence of the emphasis placed by the Taylor Society upon the establishment of standards is seen in the book published under the auspices of the Society entitled "Scientific Management in American Industry,"[3] in which one of the major divisions deals with management standards. By establishing standards one lays the foundation or base of modern management, and as a firm base or foundation is necessary for a safe superstructure, it is impossible to overemphasize the importance of standards.

If it is true that standards form the base or foundation of modern management, upon which the superstructure (control) is built, then it must also be true that if that base or foundation is not maintained, but is permitted to waste away or disintegrate, the superstructure becomes unsafe and must eventually collapse. It was the recognition of this situation that led Taylor and his associates to recognize the fact that standards were only valuable as long as they really were standards and that their maintenance was quite as important as their original determination or establishment. As early as 1893 in a paper entitled "Notes on Belting,"[4] delivered before the American Society of Mechanical Engineers, Frederick W. Taylor had the following to say with reference to maintenance:

> Serious repairs to belting, as well as to all other machinery, in a mill should be prevented as far as possible by systematic and careful inspection at regular intervals, and the writer has found a tickler, having a portfolio for every day in the year, from which reminders to inspect and examine are issued daily, an invaluable aid in caring for the machinery of an establishment. With this method a belt should rarely slip or give out while in use, and most repairs can be made out of working hours.

In this paper Taylor not only established certain definite standards for belting, but he also immediately devised a method of maintaining these standards, an idea which should be kept in mind by all who are establishing management standards. Taylor always recognized the fact that the mere establishment of a standard was only a part of a task and that the complete task was not accomplished until he had perfected a method which would assure the maintenance of the standard which he had established. The fundamental principles of maintaining standards, which Taylor set forth as early as 1893, are the principles which are used today in the plants of the country which have given maintenance of standards careful thought and study.

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[1] Paper presented before a meeting of the Taylor Society, New York, December 4, 1930.

[2] See paper by H. K. Hathaway entitled "Standards," *Bulletin of the Taylor Society*, Vol. XII, Nos. 5 and 6, October and December, 1927, pp. 491 and 540.

[3] Harper & Brothers, New York, 1929.

[4] *Transactions of the American Society of Mechanical Engineers*, Vol. XV, 1893, p. 237.

Although Taylor early had greatly emphasized the importance of the maintenance of standards, very little was done in this field of activity until quite recently, except in those plants in which he and his associates were working.

A real contribution to the literature on maintenance was made in May, 1917, when the Taylor Society published a paper by H. K. Hathaway, entitled "Maintenance of Machinery and Equipment as Part of the Taylor System of Management."[6] In this paper the method used by Taylor and his associates for maintaining standards of machinery and equipment was outlined and briefly explained.

Within recent years much more interest has been shown in the subject of maintenance of standards. That interest, however, can by no means be called widespread as yet, although there are in the country a number of companies which recognize maintenance of standards as an important problem and have well-developed methods of handling it.

The subject, maintenance of standards, is such a broad one that it will not be possible here to go into a detailed and exhaustive discussion of the maintenance of all possible standards; nor is it the purpose of this paper to give the detailed technique of the operation of every department responsible for maintaining a standard. The discussion will, therefore, be confined to the maintenance of standards of plant and equipment, tools, raw materials, worked materials, finished product and what has been called "plan of organization" and its mechanisms. It is proposed to discuss what might be called the fundamentals of the maintenance of each of the standards set forth above, and by examples to illustrate how some of these fundamentals have been successfully applied.

Maintenance of Standards of Plant and Equipment

Proper maintenance of plant and equipment has always been important, but it is only within recent years that any considerable number of manufacturing establishments have given the problem the same careful thought and attention which they have applied to other management problems, even though proper maintenance was often an integral part of the problems they were attempting to solve. There are many reasons that might be advanced to account for the increasing interest of the manufacturing community in the more effective handling of plant and equipment maintenance. It will be well to mention a few of these reasons at this point in order that some of the methods and details which will be described later in this paper may be better understood. Among these reasons are the following: (1) increased mechanization, (2) greater investments in machinery and equipment, (3) greater emphasis upon working conditions, (4) greater emphasis upon quality, (5) greater use of incentives and (6) greater use of cost accounting and budgeting.

1. *Increased Mechanization.* The rapidity with which industry at the present time is progressing in the direction of complete mechanization is remarkable. Many operations which only a few years ago were largely dependent upon individual workers both for quality and quantity of production are now to a great extent being performed by machines. Where production is dependent largely upon the performance of a machine the importance of making certain that the machine will perform consistently, in order to obtain high production, is apparent. Moreover, the failure of a machine or other piece of equipment becomes much more serious under our present methods of production. The failure of a conveyor being used in connection with the assembly of a radio set or an automobile does not merely result in the idleness of one worker. It causes every worker along that line to be idle and results in no work whatever being performed. The failure of a single machine under older methods of production merely resulted in the loss of production of one worker.

2. *Greater Investments in Machinery and Equipment.* Increased mechanization results in larger capital expenditures, so that now the amount of money invested in machinery and equipment in American factories is tremendous. Whether or not these investments will prove profitable will depend, among other things, upon whether or not the machinery can be kept in continuous operation. If this equipment is not kept in operation there will be losses because of heavy fixed charges as well as from the very rapid rate of obsolescence of many types of modern machinery. Because of this high rate of obsolescence many manufacturers insist that new equipment pay for itself in two years, and in some cases even in one year. If this is to be done this equipment cannot be permitted to stand idle for any reason which it is possible to prevent.

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[6] *Bulletin of the Taylor Society,* Vol. III, No. 3, p. 6.

3. *Greater Emphasis Upon Working Conditions.* Another important reason for the present emphasis upon maintenance is the fact that American manufacturers are beginning to realize, as they never did before, the importance of good physical working conditions, if both high production and high quality are to be obtained. Good lighting, a clean workshop, proper air conditions, are factors which promote healthy shop conditions and directly result in greater production and higher quality of work.

4. *Greater Emphasis Upon Quality.* Every year in American industry greater emphasis is being placed upon quality of product. In order to obtain quality from machines it is necessary that they do more than merely run well enough to obtain production. They must be so well maintained and adjusted that production of high quality from them is not only possible but certain. Thus again the maintenance of standards becomes of increasing importance.

5. *Greater Use of Incentives.* The importance of proper maintenance is emphasized when one considers it in connection with the utilization of incentive systems of wage payment. The failure to maintain standard conditions on a job, after the time study has been made and the rate set, has caused no end of hard feeling on the part of the workers toward the management, and the total failure of many an incentive system of wage payment which might otherwise have resulted in increased wages to the worker and increased profits to the management. It is unfair, for example, to set a rate on a machine when it is operating at a definitely predetermined standard speed and then insist that that rate stand when at some future time, because of poor maintenance, the machine only operates, for example, at 85 per cent or less of the standard speed.

6. *Greater Use of Cost Accounting and Budgeting.* Another reason why maintenance of standards of plant and equipment has assumed its present important role is because two of the mechanisms of modern management, cost accounting and budgeting, have exposed the costliness of any program which does not provide adequately for proper maintenance. Through properly developed factory cost accounting the great losses resulting from improper maintenance are exposed. Modern budgeting has brought forecfully to the attention of those in control the great sums which are spent for maintenance and has emphasized the necessity of having this work performed in a more scientific manner and at reduced cost.

Prevention

As was said before, there is relatively little which is really new in the present methods of maintaining standards, and this is particularly true with reference to the maintenance of standards of plant and equipment.

The basic idea in back of all modern maintenance is prevention. As it was pointed out earlier in this paper, Taylor as early as 1893 had written on this subject and, even before that time, was practicing preventive maintenance at the Midvale Steel Works in Philadelphia. In many organizations, even at the present time, the responsibility for the condition of machinery, equipment and buildings, is left entirely to the superintendent or foreman. While a repair department may exist, it acts only upon orders of a superintendent or a department head. It does not take the initiative in maintaining equipment to any set standard. Consequently machinery is often permitted to operate long after the time it stopped producing economically, and many times so long that serious breakdowns, resulting in expensive repairs and long, costly production delays, occur. Often no action is taken to have the machine repaired or adjusted as long as the machine is able to turn out some production, no matter how little. The costliness of such a method, in terms of excessive repair cost and expensive production delays, is apparent, as is the fact that such a method of repair of equipment is absolutely incompatible with scientific management, which is necessarily based on carefully developed standards. Under scientific management the entire shop management is based upon the idea that every machine will operate under the greatest practicable load, and failure to maintain the machine in a condition which will make this possible immediately makes impossible the highest type of shop management.

The idea of preventive maintenance is worked out by centralizing the responsibility for the condition of machinery and equipment. Instead of having every foreman responsible for the condition of his machinery, a maintenance department takes over this responsibility and assumes the initiative in seeing that the established standards are maintained. This is done by means of regular scheduled inspections, by means of which difficulties are anticipated and the machines always kept in standard condition. The attitude of the modern maintenance department is not to permit a considerable lowering of the established standard to occur, and then by repair to bring the machine up to the standard, but rather to see that the machine is constantly operating up to standard and to remedy any conditions which may result in a lowering of the standard in the future.

If a system of preventive maintenance through inspection is to be practicable a few fundamental requirements must be met.

1. Standards must be established for every piece of machinery and equipment, and every machine should be placed in this standard condition. In order to maintain a standard, a standard must be first established. In bringing existing machinery and equipment up to a standard, complete overhauling is sometimes necessary; sometimes mere adjustment suffices. Some companies in which maintenance of plant and equipment has been well developed, in taking over other factories where no systematic maintenance was practiced, make it a rule to overhaul completely all machinery and equipment to be certain that it is placed in standard condition.

2. A careful study should be made of the machinery and equipment in order to develop a schedule which will indicate the frequency of necessary inspections of the various parts to be inspected. Obviously the possibility of failure of all parts is not equal. Some parts may require daily inspection, whereas for others monthly inspections may be adequate.

3. After the schedule of inspection has been developed, a tickler file should be established which will automatically bring forth those items which are to be inspected on a particular day. This is a device which has been used with great effectiveness from the earliest days. Individuals may forget, but a properly operated tickler never forgets.

4. The method of inspection should be carefully defined. The inspector should be told definitely the items to be inspected and instructed in the method to be followed and a written report covering every item should be obtained from him. If an inspector without detailed instructions is told to inspect a given machine it is very likely that he will overlook some important part. If he is told what to inspect and how to inspect, and asked to report the condition of every item he checks, thorough inspection is assured. As a result of this inspection report repair orders may be issued, or the date of the next inspection determined if that date is to be sooner than the next regular inspection.

TABLE 1 INSPECTION TIME-TABLE FOR MAINTENANCE EQUIPMENT[*]

ITEM	PERIOD OF INSPECTION
Belting, leather—new belt	End of 24 hr. End of 48 hr. End of 1st week End of 1st month Thereafter every 2 months
Downspouts and flushing	During every storm
Drinking water system	Every day
Electric lamps	Every 6 months
Electric lamps (industry location)	Every 3 months
Fire escapes	Paint every 2 years
Fire pails	Every week
Hose	Test under pressure every year
Hose	Dry immediately after using
Insulation (steam or hot water pipes)	Every month for damages
Putty in sash	Every fall
Racks, storesroom	Every 6 months
Roofs	After every storm
Sash steel	Paint every 3 years
Sash wood	Paint every 3 years
Shafting	Every 6 months
Sprinkler equipment	Every week
Steel tanks	Paint every 3 years
Structural steel	Paint every 2 years
Tin roofs	Paint every 3 years
Toilets	Every day
Turbine, steam	Every year
Valves (heating system)	Every fall
Washbowls (office)	Twice every day
Washbowls (shop)	Every day

Figure 1

5. Best results from inspection have been obtained when the responsibility for inspection has been placed upon full-time inspectors in plants with sufficient work for such inspectors. Inspectors should be carefully chosen for their honesty and knowledge of the equipment involved, and instructed in inspection methods. The attitude that anyone will make a good inspector will lead quickly to the failure of the entire plan of preventive maintenance. The inspector should make no repairs although he may make minor adjustments in the course of his inspection. When inspection is added to the regular duties of other maintenance men, such as millwrights and electricians, it is very likely that it will be neglected. Routine duties will then be performed before inspection, and inspection will be looked upon as a means of filling in time.

6. Should a failure of a machine or a piece of equipment occur in spite of regular inspections a care-

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[*] Alford, L.P., editor, *Management's Handbook*, New York, The Ronald Press Company, 1924, p. 1043.

ful investigation of the cause should be made to determine why the failure was not anticipated by the inspection, and thus prevented. It may be that as a result of this investigation a revision of the inspection schedule will be necessary.

It is well to bear in mind that regular inspection of machinery and equipment has a very favorable psychological effect upon the worker. If he knows that his machine is going to be inspected at regular intervals and that a report as to its conditions, use, abuse and cleanliness will be made, he ordinarily will take greater care of it. This result has been noticed by a number of companies.

Regular inspections of the buildings proper, floors, lighting, piping, painting, roofs, etc., should be scheduled exactly as inspections of machines and equipment are scheduled. This portion of plant maintenance is just as important as mechanical maintenance, especially from the standpoint of safety, the provision of proper working conditions and the prevention of undue waste of the assets of the company.

Lubrication

Since the keynote of modern maintenance is prevention, any discussion of this subject without at least a brief description of the importance of proper lubrication and its contribution to preventive maintenance would be inadequate. It is in the field of lubrication that real progress has been made in recent years.

A study of the causes of mechanical breakdowns will show that a very large number can be directly attributed to the failure to supply adequate and proper lubrication. This does not mean necessarily that sufficient oil has not been used, but it does mean that there was not sufficient oil at the points which required lubrication. The losses due to the failure properly to lubricate all the points requiring lubrication and the wastes resulting from the use of the wrong lubricant and careless performance are enormous. In order to overcome these losses a number of things are being done:

1. There is a distinct tendency in the direction of making lubrication as automatic as possible, thus eliminating the human element. By these improved methods of lubrication sufficient lubricant is forced under pressure to every point requiring it. There is no need for the worker to avoid oiling certain parts of the machine because they are difficult to reach. Machine manufacturers, recognizing the importance of adequate lubrication, are equipping their machines with these devices and many manufacturers are installing such systems upon the machines which they already have in their shops.

2. The responsibility for properly lubricating machines is rapidly being taken from the machine operator, who frequently has proven unsatisfactory as an oiler, and is being centralized in the hands of a single individual, sometimes called a lubrication engineer, who is responsible for the adequate lubrication of all machinery and equipment. Along with this centralization, careful cost records, which prove valuable in the study of lubrication problems, are kept.

3. A more careful study is being made of the lubricant to use in order to ascertain whether or not it will meet the purpose for which it is to be used.

4. Lubrication surveys are being made in plants, as a result of which both the cost of oil and the cost of labor are being reduced.

5. Lubrication is being scheduled and the oiler routed, time studied, and placed on incentive systems of wage payment with considerable success.

Without doubt one of the most efficient means of preventing mechanical failures of machines is supplying adequate lubrication.

Standing Order for Maintenance Department

After standards have been established for the maintenance of plant and equipment, as indeed for any phase of the business, the development of a standing order is an invaluable aid in maintaining that standard. The standing order for the maintenance department explains in detail the purpose of the maintenance department, its functions and its method of operation. It serves as a means of placing before the members of the maintenance department the basic ideas behind maintenance work and of instructing them in the standard method of carrying out these ideas. As a device to aid in maintaining standards the standing order has been of no small importance.

It is not the purpose here to outline in detail the methods of operating a maintenance department charged with the maintenance of standards of plant and equipment. However, it is well to note that all of the principles of good management which apply to the various production units apply equally well in the maintenance department. In the past many maintenance engineers were wont to plead that their departments were different; that no two jobs were ever exactly alike and therefore that those principles of good management which were applicable in shops manufacturing a standardized, or nearly standardized, article could not be applied by them. We are rapidly learning that good management is not limited in its application to any one department or series of departments; that it is just as applicable to the maintenance department with all its variety as it is to an actual producing department. For example, carefully developed organization with definite lines of authority and fixed responsibility is as necessary in a maintenance department as in any activity. Records carefully developed to suit the needs of the maintenance department supply information which can be used in a most effective manner. Such records, for example, would be records of individual machines, giving their cost, facts about their capacity and use, location, etc., as well as a list of repairs made on each machine and the dates and cost of these repairs. These records give very valuable information with reference to the performance of every machine. They often result in information leading to the redesign of parts and are valuable in the purchase of new machines. Job study and the application of various types of incentive wage payment are being used in some maintenance departments and give evidence of good possibilities. Accurate information with reference to maintenance costs is being kept and maintenance budgets are being used in many companies. Maintenance work can be as successfully planned as the work of the average manufacturing department. While one still occasionally hears the old objections, setting forth the difficulties of maintenance management, there can be no doubt whatever that maintenance management has improved remarkably within recent years.

Maintenance of Tool Standards

In any discussion of the maintenance of plant and equipment it is desirable to emphasize particularly the importance of tool maintenance. This problem, after proper tool standards have once been established, involves a discussion of: (1) tool inspection, (2) tool repair and (3) proper storage and control of tools.

1. *Tool Inspection.* In order that the established standards of tools may be maintained it is necessary that no tool be returned to its storage place in the tool room unless it has been first inspected. It is also necessary that all new tools which have been purchased be carefully inspected in order to determine whether or not they meet the established standards. This inspection of tools is an essential portion of tool-room operation and cannot be omitted if standards are to be maintained. A definite inspection code should be developed indicating what each type of tool is to be inspected for, and what inspection tools are to be used in making the inspection. Such an inspection code is shown in Figure 2.

TABLE 3 INSPECTION CODE[7]

TYPE OF TOOL	INSPECT FOR	INSPECTION TOOLS
Arbors, Mandrels, etc.	Freedom from scratches or flats, wear, condition of centers	Snaplimit gage, or micrometer
Clamping Bolts	Condition of thread, condition of nut	
Gages	Size	Master gages
Hammers	Condition of head, condition of handle	
Lathe	Sharpness, soundness (freedom from cracks, chips, etc.), correctness of cutting angles, height of nose	Height gage, angle gage
Milling Cutters	Sharpness, soundness	
Planer	Sharpness, soundness (freedom from cracks, chips, etc.), correctness of cutting angles, height of nose	Height gage, angle gage
Reamers	Sharpness, soundness, size, condition of wrench shank	Micrometer or limit gages
Taps	Sharpness, wear, condition of shank	Screw gages
Twist Drills	Sharpness, condition of point, condition of shank	
Wrenches	Size of opening	Standard nuts

Figure 2

2. *Tool Repair.* Tools which cannot pass inspection should be repaired so that they will meet definitely established standards before they are returned to their place of storage in the tool room. The tool-repair department is usually operated in connection with the tool room. Tool repair should not be left to the workers in the shop.

3. *Proper Storage and Control of Tools.* One of the functions of the tool room is to supply the proper standard tools to the shop when required. In order to do this it is necessary that the tools be properly

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[7] *Management's Handbook, op. cit.*, p. 585.

classified and stored in the tool room and that they be properly charged to the persons using them.

If tools are not maintained in standard condition, neither quantity nor quality work can be turned out by the producing departments.

Maintenance of Quality of Standards

Present-day competition is forcing the production of a product whose quality is constantly being improved. Present-day production methods, involving the large use of interchangeable parts which must be assembled rapidly and without fitting along a moving assembly line is forcing the adoption of close manufacturing standards. Present-day management methods involving careful production planning control of work and the utilization of incentive systems of wage payment demand that quality standards be closely maintained.

In discussing the maintenance of quality standards, it is well to divide the discussion into a consideration of: (1) maintenance of raw material standards, (2) maintenance of standards of material in process and (3) maintenance of standards of finished product.

1. *Maintenance of Raw Material Standards.* Increased numbers of manufacturers are using specifications for the purchase of materials and are carefully maintaining the standards set forth in the specifications by inspection upon the arrival of the material at the factory. In the case of materials, as with any other standards, the standard is valuable only when it is properly maintained through careful inspection. In the report on "Recent Economic Changes in the United States," the following statement is made with reference to this subject:[8]

> . . . Buying upon specification and checking by testing laboratories has become the going practice. Most of the larger companies, and many of the smaller ones, have their own laboratories; and commercial laboratories are freely used by them as well as by those which cannot afford their own. Practically all managers report that they are increasing the precision of their specifications, which in the larger companies comprise several printed volumes. Some work out their own specifications, as must be done in special cases; but, for the more staple items, the large majority are using the published standards which leading trade associations have been active for several years in developing. The American Society for Testing Materials and the American Engineering Standards Committee have had large shares in this development, and a considerable number of companies are using to an increasing extent the specifications of the United States Bureau of Standards.

As an example of the care being exercized in a number of plants to be certain that materials supplied are in accordance with established standards the following example is given. In a full-fashioned hosiery mill manufacturing a high-grade product the greatest care is taken to see that all materials are standard. In addition to the usual tests to which shipments of silk are subject, it is examined upon a seriplane, a machine having a black board upon which the silk is carefully wound one thread at a time, and no two threads upon each other. The black background upon which this silk is wound makes the evenness of the silk clearly visible. The appearance of the silk while wound on this board is compared with a standard card and the silk rated in a percentage figure. Unless the silk comes up to the established standard for evenness it is rejected. In the same mill, before silk is used in the plant, a sample is run through a series of machines and a careful record of the number of times the thread breaks with the reasons for the breakage is made. These figures are tabulated for every lot of silk and unless the established standard is met the lot is rejected. The advantages of making these tests are evident from the standpoint of turning out a high-quality product, free from the imperfections caused by the use of poor material. Standard material also results in better labor relations, inasmuch as the rates of pay are uniform and the wages are not dependent upon whether or not a good lot of silk is being worked upon.

2. *Maintenance of Standards of Material in Process.* Maintenance of proper quality standards of materials in process may be said to depend at least in part upon the following conditions: (1) definite and reasonable quality standards; (2) supplying the worker with the proper materials, machines, tools and equipment to perform the job, as well as the use of properly maintained measuring devices both by worker and inspector; (3) the position of the inspection department in the organization and a proper consideration of where the ultimate responsibility for quality in an organization rests; (4) the development of the idea of preventive inspection and the development of co-operation between workers and the inspection department.

In setting up quality standards for manufacturers, these standards should be definite and fixed, and there should be no doubt in the minds of either the worker or the inspector as to what the standard is. The standard should also be reasonable and consistent with the conditions under which the work is to be done and the purpose for which the article is to be used. The design and the engineering departments can be of great assistance in this connection.

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[8] Dennison, H. S., on "Management" in *Recent Economic Changes in the United States,* McGraw-Hill Book Company, Inc., New York, 1929, p. 510.

If proper standards of quality are to be maintained in the organization, it is desirable that the inspector should not report to an organization executive whose interest is primarily in quantity rather than quality. Nor should the inspection department be looked upon as being alone responsible for the quality of product. The inspection department is merely the instrument for checking the quality of work produced in the organization, to be certain that it comes up to the established standard. The ultimate responsibility for maintaining and enforcing quality in an organization rests with the foreman and workers in the producing departments.

The maintenance of a high standard of quality in an organization is also to a large extent dependent upon the attitude of the inspector in enforcing quality. The idea of prevention in connection with inspection, which was spoken of before, is important here also. Instead of merely rejecting work which does not meet the established standard, the inspector should indicate the cause of rejection and take the necessary steps to have the cause remedied, so that it will not be the reason for future rejections. Unless this is done much poor work will be repeated unnecessarily. Rejections are often caused by the failure of the worker to understand instructions, by his using wrong methods and poorly maintained machines and tools in performing an operation. If the inspection department will act to remedy these conditions, rather than merely reject work which does not meet the established standards, the result will be co-operation between workers and inspectors rather than the antagonism which now exists between these two groups in many organizations.

3. *Maintenance of Standards of Finished Product.* Maintenance of standards of finished product involves the same careful inspection which the maintenance of other standards requires. In some organizations at the present time this final inspection of product is performed by sales inspectors, or what have been called in some organizations consumers' representatives, who are in no way connected with the production department. They have complete authority to reject whatever articles they desire. The basic idea behind this plan seems to be that a product may pass a factory inspection but may nevertheless still be unsatisfactory from a consumer's point of view. It is the purpose of this inspection to look at the product as a consumer would look at it in order to decide whether or not the consumer would be pleased with it. In these days of severe competition, the product must not only be technically correct but it must also be attractive to the consumer.

Maintenance of Plan of Organization and Its Mechanism

The maintenance of a plan of organization and its mechanism is a phase of maintenance of which one hears and reads very little, yet from the standpoint of scientific management it is just as important as any other phase of maintenance.

After the plan of organization has been carefully studied and worked out, standards established, routines developed and the business placed in condition to function in a most effective manner, it has often been assumed that it will do so without any further attention. Experience has shown that this is not so. Unless the plan of organization and the mechanisms which were developed in connection with it are constantly examined and inspected, members of the organization will gradually fall back into their old methods. The resulting condition is apt to be worse than the original one, since the organization will now be going through motions which will mean nothing. This slipping from the original plan will probably start by making so-called short-cuts or improvements due to a failure to understand the purpose of the mechanisms which were developed. This has occurred in many instances where consultants after reorganizing a business have not been retained to follow up their work by regular inspections. In such cases the consultants should be retained after the original installation is completed so that they may make certain that the plans of organization and the mechanisms which they devised for the particular company are being used as they should be used, and that there are no omissions or additions, unless they have been carefully considered by the persons most familiar with the reasons for their original adoption or omission.

Taylor recognized the importance of this type of maintenance and constantly emphasized it in his writings. In his work "On the Art of Cutting Metals"[*] he says:

> Even if these written instructions are sent to the machinist, however, little attention will be paid to them unless rigid standards have been not only adopted but *enforced*, throughout the shop for every detail, large or small, of the shop equipment, as well as for all shop methods.

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[*] *Transactions of the American Society of Mechanical Engineers,* Vol. XXVIII, 1906, p. 54.

Again in "Shop Management"[10] he says:

> Perhaps the most important part of the gang boss's and foreman's education lies in teaching them to promptly obey orders and instructions received not only from the superintendent or some official high in the company but from any member of the planning room whose especial function it is to direct the rest of the works in his particular line: and it may be accepted as an unquestioned fact that no gang boss is fit to direct his men until after he has learned to promptly obey instructions received from any proper source, whether he likes his instructions and the instructor or not, and even although he may be convinced that he knows a much better way of doing the work. The first step is for each man to learn to obey the laws as they exist and next, if the laws are wrong to have them reformed in the proper way.

It will be noted that Taylor did not say that if a standard was once established it should not be changed under any conditions. He believed that if it could be shown, after careful study, that a standard could be improved then it should be changed, but that it should be changed only by those who had set the original standard and were in a position to determine whether the suggested change was really an improvement or merely the desire of someone to have it changed for change's sake.

Dr. Harlow S. Person well summarized the need for constant vigilance in maintenance in Chapter I of "Scientific Management in American Industry"[11] when he said:

> The operations of an enterprise are the affairs of normal human beings and are subject to all influences of human nature — misunderstanding, inertia, inhibitions, carelessness, laziness. Training to do things according to a newly discovered "best way in the present state of the art" is a condition of learning with all the backslidings that result from the struggle between old and new patterns of conduct. A man may resolve to do a piece of work in a newly discovered best way with all the enthusiasm with which he resolves to grease and oil his new automobile precisely as set forth in the instructions; but six months later performance has declined from high resolve as badly in the one case as in the other—and for the same reasons.

Regular inspections are the method whereby the standards of organization mechanisms, procedures, etc., are maintained, just as they are the means of maintaining standards in general.

Conclusions

This paper includes a discussion of the maintenance of only a few of the many standards which might have been considered. It has not been our purpose to consider in detail the technique of operation of any of the departments responsible for the maintenance of standards, but rather to consider the subject in a broad sense and to give some of the fundamentals and problems involved.

To establish standards in an organization is to raise the level of performance in that organization. Whether the established level is to be maintained will depend upon whether or not the standards are maintained. Maintenance of standards acts very much as a ratchet in preventing the established standards from seeking a lower level.

If standards are to be maintained, responsibility for such maintenance must be definitely fixed in the organization and a detailed technique developed for carrying out this responsibility.

The principle upon which modern maintenance is based is the prevention of variations from established standards by carefully planned inspections, the techniques for which have been developed as a result of research and investigation. These inspections are carefully scheduled, according to the frequency necessary for effective control, and a tickler file provided to be certain that the established schedule is maintained. In determining the type and frequency of inspection, its cost must be balanced against savings resulting therefrom.

If standards are to mean anything in an organization, and if they are to be properly maintained, they must be reasonable working standards. From a practical point of view it is impossible to maintain standards which are unduly severe.

In the maintenance of all standards, standard practice instructions or standing orders are an invaluable aid, and their importance can hardly be overemphasized. Every department responsible for the maintenance of a standard should develop a standing order which covers its work and sets forth its purpose, functions and procedures.

Departments responsible for the maintenance of standards should exercise an influence in the direction of the development and improvement of existing standards. Through the work of inspection much valuable information will be obtained for this purpose.

The importance of the maintenance of existing standards in an organization is as great as the importance of the standards themselves. Failure of proper maintenance means the loss to the organization of the difference between what should have been and what actually occurred. Without proper maintenance of standards scientific management could not exist as, without maintenance, there could be no standards, and standards are the foundation of scientific management.

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[10] Harper & Brothers, New York, 1911, pp. 138-40.

[11] P. 5.

To the worker the establishment and maintenance of standards in a shop means that the relations between management and men are likely to be good, as an important cause of disputes is removed. This is especially true if the worker is operating on piece work or an incentive system of wage payment.

Low-grade materials, lack of well-defined standards of quality, machines which are out of adjustment, poor working conditions, incentives based on standards which are not maintained, cause no end of ill feeling between the men and the management.

One cannot overstress the importance of constant vigilance in the maintenance of standards. Standards without maintenance are soon no standards at all, and their existence in the organization may prove most dangerous from the standpoint of shop operation and plant morale. L. C. Bryant in "Scientific Management in American Industry"[12] well stated the importance of the maintenance of standards when he said:

> Factory operation standards are of value only as long as they are maintained. It is a human characteristic to follow the line of least resistance and be satisfied with something slightly poorer than the best, and if this characteristic is allowed to act there will be a sloughing off in the quality of standards. With the fall of the standards comes a similar decline in accomplishment and personal responsibility. The cycle repeats itself until the condition of the standards reaches a level slightly lower than the desires of the man in a rut. Eternal vigilance is required to maintain standards.

There can be little doubt but that importance of the maintenance of standards is recognized more at the present time than at any time in the past, and that with the development of scientific management in the future even more attention will be directed to this important phase of management.

Discussion

Henry Post Dutton.[13] Mr. Karabasz' subject is a broad one and he has been wise to limit himself to two or three examples and to give specific data on those. The subject of maintenance of standards covers practically all fields of management, for every order is at least a temporary standard, and seeing that an order is properly carried out is a case of maintenance of standards.

Mr. Gates in his paper last night, I thought, brought out a point which also appears in this morning's papers. A standard may be thought of in two parts, which are supplementary. The real standard is, in most cases of performance at least, a habit which the members of an organization have perfected. After this habit is formed, maintenance of the standard is the passing on of the habit to new men as the personnel shifts, and the prevention of a drift from the standard which might result from forgetfulness or poor workmanship. Written procedures are a necessity because of the impermanence of a working force and the fallibility of human memory.

Human memory is particularly uncertain where the performance required is repeated intermittently rather than constantly, as in the case of maintenance inspection. Where the thought stream flows continually in a single channel there is a certain tendency to variation, but in the main the performance is relegated to the habitual, only half-conscious levels of thought. Where performance is occasional it depends wholly on memory. A great deal of effort is saved if the reminders for such performance are made automatic, as they are by a tickler file or set program. It is even better to make the regulation wholly automatic where this is possible, as by the self-replacing lamps used on flying fields, automatic temperature controls, relay switches and the like.

I would like to add one point to Mr. Karabasz' excellent discussion. Perhaps it applies more to the setting than to the maintenance of standards, but it is one of those points in which the setting of the standard will be influenced by the problem of maintenance. This point is the setting of tolerances.

We can lay it down as a general rule that for any mechanism to function, its parts must conform with a degree of variation not in excess of a certain critical value. If you take an ordinary pencil or pen cap, which is held in place by friction, there will be an upper limit of size beyond which the cap will be too loose to stay on, and a lower limit below which it will be too tight to go on. This much is elementary.

We can usually say further that the closer the tolerances beyond these critical limits, the better the service given. One of the principal differences between good cars and cheap ones is presumed to be the finer workmanship, the closer and finer fit of bearing surfaces which eliminates vibration and wear.

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[12] P. 226.

[13] Professor of Factory Management, Northwestern University, Chicago, Ill.

It is also generally true that the permissible tolerance tends to bear a fixed ratio to size, rather than remain a constant quantity as size increases. In the field of psychology this relationship is known as Weber's Law, which is that the least perceptible difference between quantities tends to bear a fixed ratio to the quantity. An extension of this principle gives us the preferred number series, which makes each step in a series of sizes, as of tools, lots, coins, etc., bear a constant ratio to the next smaller size. This relationship is found practicable because the fitting of a stepped series of sizes to a natural series which is usually continuous, involves an application of the principle of tolerances.

Now, to produce an article mechanically involves the simultaneous application of a good many forces, and these forces are constantly varying slightly. The tool never cuts twice the same, for it wears slightly with each cut. Other forces enter in, making all sorts of combinations possible, just as natural series, the height of people, for instance, vary continually.

If, however, these forces are of constant tendency, the results tend to vary around a normal point, and the variations in product will be less frequent as the number of units is greater. This will give the well-known bell-shaped curve of probability. (Figure 3, *a* a'.)

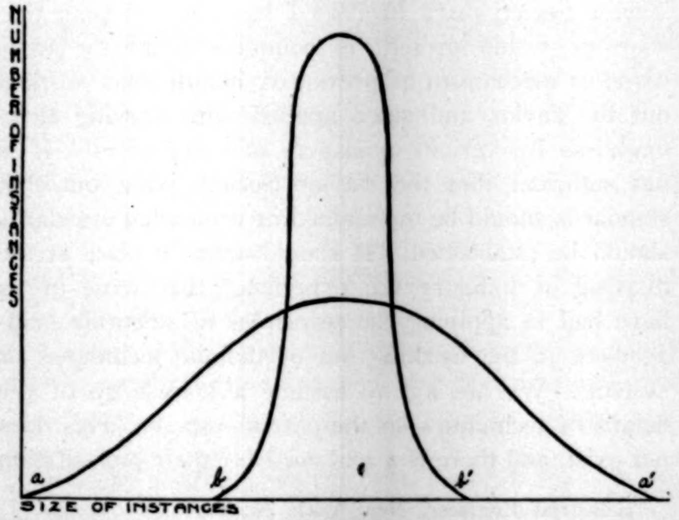

Figure 3

Now there is a fairly definite balance between the advantage of a close tolerance and its cost. Both may be appraised, if desired, in dollars and cents. The factor of desirability will reflect itself in increased value, price or service. The factor of cost will be reflected in one of two ways. A closer tolerance will either involve a larger percentage of rejections (for example, moving the limits from *a* and a' to *b* and b') or it will involve a closer and presumably more costly process control which would make rejections unnecessary.

There is evidently a balance also between rejections and the advisability of using a more costly process of manufacture. I assume that the operators have been trained and are being inspected to secure the full possibilities of the given process. Mr. Gates illustrated this point last night when he said that, if it was not practicable to meet quality requirements by teaching the operator, it should be the responsibility of the engineering department to work out new production methods.

This idea of tolerances and permissible limits has many applications outside the field of product inspection. It determines whether a time plan of schedule control, such as the Gantt chart, or a sequence plan like the Taylor planning board, shall be used. It applies to discipline and, in fact, like Mr. Karabasz' other principles, is applicable to the whole field of management.

Perry A. Fellows.[14] In his paper on the "Maintenance of Standards," Professor Karabasz has demonstrated that it is possible to gain some valuable truths for general application from a study of particular phases of plant operation. He has also demonstrated that he knows his subject backward as well as forward by discussing standards of maintenance as fully as he does the maintenance of standards.

The thing we must not miss in following this valuable paper is the statement made that "all of the principles of good management which apply to the various production units, apply equally well in the maintenance department."

Management is leadership and the qualities of leadership are universally the same. The leader must have in view some definite goal toward which he is striving and he must be able to inspire others to follow him toward that same goal. To the extent that he fails in either of these requisites he will fail as a leader. To the extent that management fails in either of these requisites it becomes mismanagement.

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[14] City Engineer, Detroit, Mich.

Professor Karabasz offers us a discussion of the standing order for the maintenance department which is especially interesting. He says:

"After standards have been established for the maintenance of plant and equipment, as indeed for any phase of the business, the development of a standing order is an invaluable aid in maintaining that standard. The standing order for the maintenance department explains in detail the purpose of the maintenance department, its functions and its method of operation. It serves as a means of placing before the members of the maintenance department the basic ideas behind maintenance work and in instructing them in the standard method of carrying out these ideas. As a device to aid in maintaining standards the standing order has been of no small importance."

We say this particular part of his paper is especially interesting because here can be found the fundamentals upon which all the rest is built. To begin with we are reminded again of the fact that even though the application in this instance is to the maintenance of standards in the department controlling the maintenance of plant and equipment, the principle is capable of general application. In addition to this we have set up in this quotation the fundamental concepts of good management and some idea of their relationship. The goal and complete instructions for arriving at that goal; the ideal and the inspirational advice as to the means for reaching that ideal; the standing order and the maintenance of standards, these should all be the same in the hands of competent management.

Of course, we are not expected to infer from the quotation that the purpose of the department does not emerge until after the standards are set. It simply marks the first appearance of the purpose of the department in this particular form. It must be further understood that the standards of the maintenance department cannot very well be properly established until the purpose of the department is very clearly defined. This applies as well to other departments.

We have then the necessity of knowing what the purpose of the department is and when the purpose is once set up in clear and unmistakable terms, but not necessarily in spoken or written words, the route to be followed in accomplishing it may be discovered.

On the leader or manager rests the responsibility of knowing and interpreting the purpose of individual effort. It is he who must discover for the individuals the paths which are to be followed to accomplish that purpose. The methods of outlining these paths vary through a wide range. All the problems of time and space and humanity are concerned. Some of the tangle is so difficult that the paths are quite uncertain. In other cases, for at least a part of the way, the direction of progress is so clear and is traveled so often that it can be charted and maintained as a standard just as definitely as we map and maintain our national highways.

Albion N. Doe.[15] After reading Professor Karabasz' paper I talked with several of my friends in industry in an effort to get their experience in the field of standards maintenance. The general consensus of opinion was that the important elements in the problem are that standards be right before they are accepted, that they be enforceable and that there be those in the organization with continuous authority to get them enforced.

King Hathaway.[16] I am interested in the whole subject of standards—their establishment and maintenance—and especially in one rather narrow phase of the subject. The discussion has so far been on such a broad plane that this has not been particularly stressed.

Since I presented a paper on maintenance before the Taylor Society back in 1914 I have been hoping that someone would present in complete detail the technique or mechanism of preventive maintenance worked out by Taylor and since applied with varying thoroughness by various managers and engineers. It is not sufficient that the Taylor Society point out that standards should be maintained or even what standards should be established. It should actually place at the disposal of industry the experience that some of us have had in applying the principles of scientific management to the working out of definite techniques or systems. We are apt to assume a knowledge of the details of techniques on the part of others. This does not exist, and there is a real need for their presentation in a form understandable not only to the general manager, but to the superintendent, the lesser executives and others of the operating group.

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[15] Industrial Engineer, New York, N. Y.

[16] Manning, Maxwell & Moore, Inc., New York, N. Y.

In my own experience I have felt this need very keenly during the past few years. While I was in Japan I undertook to assist a company to improve its practice in the cutting of metals and I had the greatest difficulty in laying my hand on data which would enable me to advise them on the proper feeds and speeds at which their machines should be run for the various classes of work on different metals. I felt the need for a practical handbook on the cutting of metals. If any of you should go into a machine shop today and start to check feeds and speeds you also will realize this need. You will find that to the average works manager or superintendent such expressions as preventive repairs, maintenance of machines, the establishment of standards and standing orders for maintaining them mean very little. If machinery is to be so maintained so as to allow workers to do their work in accordance with the best performance standards which have been established, there must be a well worked out system, such as those in several instances worked out and applied in accordance with Mr. Taylor's principles. We need the details of such systems to supplement Mr. Karabasz' paper.

An outstanding example of this, namely, the care and maintenance of leather belting was first described by Taylor in his paper, "Notes on Belting." I have with me a copy of the standing order describing the system which was originated by Taylor and further developed by his associates for the maintenance of leather belting.[17] It embodies in a simple form all the elements of a complete maintenance system, including the planning and performance of repairs to avoid breakdowns and interruptions to production. This one example might serve as a basis for developing a complete maintenance system.

I have also a copy of a standing order defining the functions of the maintenance department in the plant of one of my pre-war clients.[17] It, too, falls short of being a description of a complete system. Again I hope someone will take up the task of making such a complete description.

Professor Karabasz might have given more weight to the moral effect on the workman of well-maintained standards of equipment and conditions. If workmen know that their machines and tools are kept in first-class condition they proceed with greater confidence and are more certain to attain the production standard than if they lack that confidence.

One thing that must be carefully guarded against is the tendency to discard maintenance and inspection systems at the first sign of depression. Management has a tendency at such times to take every opportunity to cut down expense. They find repair bills are low and immediately want to cut down on inspection. If they do so it is the beginning of serious trouble.

I want in closing to stress again the importance of making specific techniques as well as the principles and philosophy of scientific management available. It is of equal, if not greater, importance to tell people *how* a thing should be done as to point out *what* should be done. So much has been done that should be placed at the service of all in charge of industry. I had a funny experience when I visited a plant the other day. A new manager showed me a printed form of route sheet which he had discovered in another plant and thought pretty good. He was going to adopt it and I had to inform him that the form had originated in his own plant in 1910. That shows how great is the need for keeping before people the work that has already been done.

I hope you will all give more thought to the presentation of the techniques of scientific management in such form as to enable people to apply them.

We often refer to the three divisions of planning: (1) *determination* of function; (2) *how* the functions are to be performed; (3) *when* they are to be performed. We have pointed out in the paper and discussion this morning what should be done. The next thing we should take up is *how* it is to be done. Supplementary papers might be worked out on the maintenance of machinery, of tools and of other conditions affecting the performance of work, on the maintenance of quality or inspection, etc. We may know a lot about these things but we have considerable difficulty in getting our ideas across to the works manager unless we give him concrete examples of application.

Professor Karabasz pointed to the importance of maintaining a system after it is set up. Through neglect and failure to check, these systems fall into disuse. The example of the man who discovered his own form in another plant is a case in point. If the Taylor Society would devote itself to the task of carrying on the discussion of this subject it would be rendering a real service to industry.

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[17] It is not possible to include these important papers in this discussion. It is, however, planned to print them as separate papers in a subsequent issue of the *Bulletin*.

Percy Brown.[18] I was connected with a typewriter manufacturing concern at the time it was building a new plant. As engineer I was so thoroughly sold on Taylor philosophy as to be able to sell the management a strictly Taylor functionalized plan of operation. When we opened up the new factory the plan went into effect. We had supervisors, instructors and a tool conditions inspector, three functionalized foremen. We had had to coin names as we did not like the word "boss" and, as we had only four hundred employes, we used only one tool-conditions inspector. We realized the importance of getting the right man for the tool-conditions inspection job and finally asked the head of our tool room if he would take it over for two years. We had him do just one thing, anticipate breakdowns by a constant study of all conditions. The word "tools" was used in an all-inclusive sense to cover everything from countershafting down to the smallest tool. We gave him authority to stop any production process if conditions were not right, and he used the authority.

An indirect result of this set-up was a marked decrease in accidents because this man began to act as a consultant in safety. Matters of safety were the function of the works engineer, as well as the maintenance of countershafting, but the tool-conditions inspector did very effective work in an auxiliary way.

We were able to discontinue this tool-conditions inspection as a separate function, as well as the separate instruction function, after about a year and a half. During that time we found it possible to lay out the departments so that one man who had had charge of supervision in two or three departments, together with his assistant, were given complete control of supervision and instruction in a smaller unit, and we were able to train them to maintain the standards which had resulted from the functional foremanship just described.

We had in the meantime to set up a tool-inspection service between the manufacture and the conditioning of tools. Let us take for example the punch press. In working out a time for sharpening tools and rebushing holes we stumbled upon a practice which has been in use ever since. Certain records were maintained in the tool room which showed an optimum run for certain tools; some might run longer but it was better to condition them at fixed intervals.

As a result we became interested in a control based on the quality of the product the tool was turning out. We took the twenty-five last parts made on a die, wired them together and sent them to the tool inspector together with the tool that made them. He would compare each part with the blue print, check the tolerances and inspect the tool. He would then order the necessary repairs or sharpening, or if the tool was all right put it on the shelf together with the twenty-five parts. These parts served also as a reserve which often helped us through a production problem. This is the only case of such a technique that I know of, though I think it is logical and should prove beneficial in many instances.

Another point I should like to make concerns the importance of raw-material quality. It is not sufficient to set up standards and then put it up to your suppliers to meet them. Shop tests are necessary, and many firms are making the practice of testing materials under actual working conditions as well as in the laboratory.

The question of alignment is an especially important one in the manufacture of typewriters. The user does not like it, for example, if an "e" is out of line. We, of course, had a completely standardized practice for the assembly of all parts—standardized trays with completely standard counts, every part in the same relations to every other part in the tray year in and year out, standard rates and standard instructions for performance, so that the whole was habitual and automatic. A simple method of control consisted of a card with tear-off stubs for each operation. As the machine traveled and accumulated parts we gathered information from one part of the stub, the operator kept the other as a basis for his daily record of performance. When the machine had passed final inspection we had a complete record of every operator who had worked on it. We kept these records for years in our files. We wrote a sample with the number of the machine on it, after the machine had passed inspection, and when dealers complained of any specific fault they would give the machine number. In that way we were able to record against every inspector the number of complaints, by kind, each month. From this we worked out a "batting average" for inspectors and were able to list each man's quality record periodically for comparison with the standard. When we charted these results we had a pretty good picture of the weaknesses of management. Too great production pressure, too much overtime, mental depression as a result of slack work, etc., were reflected in the final product.

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[18] James O. McKinsey and Company, Chicago, Ill.

C. W. F. O'Connor.[19] I had an opportunity to read Mr. Karabasz' paper through the courtesy of Dr. Person and have been reminded of a paper presented by me a number of years ago. Some questions raised at that time have not yet been answered. The paper presented has, however, been invaluable to me as a check-up on my own practice. We have a small force with little turnover where things become pretty automatic. There is also a tendency in such a situation to become careless. Such a paper as this gives an excellent opportunity to check oneself mentally and physically while away from the job.

Morris L. Cooke.[20] How is it possible to discuss the subject of standards maintenance before the Taylor Society without mentioning indexing? I had had experience with several large organizations before I came under the influence of scientific management and found it was a practically impossible task to maintain even a carefully worked out standard. We had competent, willing workmen but it was surprising to see how soon personal judgment was substituted for a carefully worked out procedure or practice.

Shortly after I met Mr. Taylor I had two experiences. One was with an organization which repeated a great deal of its work intermittently, most of it at periods of one year. Without turnover or the normal changes in staff, employes forget adopted practice from one period to the next. A bit later I had four clients in competing lines. Each knew that I was working for the others and I had their permission to make my work as helpful for all as possible.

These two experiences put me right up against the question of indexing in order to make our adopted standards available at all times to anyone interested. I remember hearing Mr. Taylor say that unless you symbolized there was relatively little to be gained in entering upon the way of scientific management, simply because a great deal of the expense of working out standards was apt to be wasted. No matter what care is exercised in the absence of a comprehensive indexing system the lapses from adopted procedures become so aggravated that the expense of evolving the procedures is not warranted.

Anyone who has started out properly to index everything in an industry is apt to be surprised on the one hand by the thousands of ramifications of the standards adopted and on the other by the absence of conflicts.

Some of us are kept from writing out in detail our standing orders and instructions because we feel they are not going to be referred to. The average man thinks of the workman as referring to his instruction card at each change of operation. Of course he does not do this and is not expected to do it. We make instruction cards to act as a safeguard against thoughtless variation—not to have something to hold constantly in the hand. Taylor's idea was that some one person in the organization should be the custodian of all such records. You may need to refer to some of them only once a year, to others only once in five years, but they should be filed in orderly fashion so as to be available when the need arises. Those who have had experience with mnemonic symbolization know how easy it is for those who have had only superficial instruction in indexing to locate things promptly under this system.

I once presented one of these standing order files in bound form to Mr. Taylor. Shortly after he was called upon by some gentlemen whom he wished to show a balance sheet. He was unable to locate one among his own papers so turned to my file, which he had never opened before, with the remark that he was going to find out if my indexing system was any good. He was able to put his hand on the balance sheet immediately. Later he told me that he would have given me the devil if he had not found it, as he had been lauding the ease and effectiveness of mnemonic symbols to his visitors.

G. E. Schulz.[21] On this matter of standards maintenance I think it is important that we keep the general usefulness of organizations in mind. One can imagine a company with a perfect system of maintenance for its machinery which was nevertheless completely out of the running because its machines, or its products, were out of date. Just as human beings must disintegrate so it is with organizations. Many must be replaced in their entirety just as the old automobile must be replaced in time. It is necessary to have a progressive and constructive approach to this whole question of maintenance. On the other hand it is possible to maintain organizations and a considerable number are managing it. I know of one very able engineer

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[19] Production Superintendent, Universal Winding Co., Providence, R. I.

[20] Consulting Engineer in Management, Philadelphia, Pa.

[21] Mohawk Carpet Mills, Amsterdam, N. Y.

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who was engaged to go over all the machinery of a very large organization. He made it his aim to eliminate repairs. With this end in view he first examined the materials used in the manufacture of their machines and tools to see if they were right. In a plant employing from two to three thousand workers this approach resulted in a saving of six or seven thousand dollars in the first year. The securing of proper steels for functional parts was alone responsible for the saving. And this was not a poor organization, but, on the contrary, an exceptionally good one.

If we do not have the progressive attitude our maintenance ideas will not work out so well. I know of a firm that recently bought some new machines exactly like some very good machinery which they still had. The new machinery, however, produced 10 per cent more product with the same workers and the same material. But this organization is not interested in putting the old machines in condition to get that extra 10 per cent out of its workers and its investment. A thing may be desirable but still impossible to accomplish.

Hudson B. Hastings.[22] There are two additional aspects of this problem of the maintenance of standards to which I would like to draw attention.

Under the stress of competitive sales conditions and the natural desire for perfection, standards are not infrequently set up which involve unnecessary difficulties of management and wasteful expenses of operation. The economic and social costs of varying degrees of perfection should be measured against their real value to the company and the ultimate consumer. No standard should be established without a cooperative study, by both buyers and sellers, of all of the factors involved.

The personnel aspects of the problem also deserve careful attention. A system of control for the maintenance of standards may work well in one plant and poorly in another. The personalities of both foremen and workmen have much to do with the smoothness of operation of any plan. We have long been accustomed to the desirability of drawing up scientific specifications for the raw materials which are appropriate to the required standards in the finished product. Research work in the field of personnel has disclosed a similar need for the proper selection and preparation of the supervisory and working forces. Changing standards often call for changing personnel.

The National Committee for Time Study in Germany[1]

By OSCAR KNOOP

President of "Refa," Berlin

DURING my latest visit to America, in May, 1930, I had the great pleasure of talking with Mr. H. S. Person about various questions of organization in industry, and especially about the question of time studies. Similar basic ideas about the economic significance of this question, which, alas, as yet is all too little appreciated by the general public, led Mr. Person to suggest to me that I write a short account for the BULLETIN of the organization and development of the National Committee on Time Study in Germany, called "Refa" for short, with which suggestion I gladly comply.

Immediately after the ending of the War there appeared, especially in technical circles in Germany, an earnest attempt to exchange common experiences and ideas. Everywhere special industrial committees were formed for the sole purpose of restoring prostrated industry through the best possible rational management and methods of labor. We realized in advance the difficult years which German economic life had before it, through the high taxes and the burden of reparations, which in the end would have to be produced by the laboring population. Consequently we were aware that only the highest rationalization of work processes would make it possible, if it were possible at all, to bear these burdens. On behalf of the government the Reichkuratorium fur Wirtschaftlichkeit (National Committee on Industrial Economy) was created which should further profitable work of all kinds in all districts. The most interesting committees for our purpose were the Committee on Industrial Efficiency and the Association of German Management Engineers, and they were strongly supported.

At this time a Committee on Time Study was organized for the purpose of developing time-study specialists uniformly trained to go into a factory and there determine accurate standard times. Best suited for this purpose was preliminary experience in the metal industry. By arrangement with the Association of Berlin Metal Industries and the Society of German Engineers a committee was established which organized research courses for the first time in 1922. Herr Director Hegener von Ludwig Loewe, who shortly before had written a book on time study, was active in these research courses. The courses lasted from September to April, that is, during the winter months. The result of this work was so satisfactory that it was decided to extend the organization throughout Germany. For this purpose the National Committee for Time Study, which received the abbreviated name of "Refa," was established. Industry, in association with the Industrial Society of German Management Engineers and the Society of German Engineers, established twenty-two regional boards scattered over the whole of Germany. These boards were concerned with arrangements for training courses and were responsible for their results.

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[22] Professor Industrial Engineering, Sheffield Scientific School, Yale University, New Haven, Conn.

[1] Translated by Mary T. Person, Dobbs Ferry, N. Y.

But it was now necessary to create material for instruction. For this purpose we turned to industry, which most readily placed its experience and support at our disposal. The fundamental principles were worked out and tabulated in a graphic manner in special commissions which considered chiefly the program of the course, and from these the students were instructed. They learned in a strictly mathematical way how time studies are made and how they are estimated. The hours of instruction took place after working hours; they were regularly evening courses.

The material for instruction is divided into a series of special folios. In each folio a special branch is treated. At the present time there are in existence instruction folios for cutting processes—that is, for turning, planing, milling, drilling, etc.—for foundry materials and for wood working. A folio is in preparation for the manufacture of work tools. There is now a comprehensive Refa Book which sets forth the basic principles in accordance with which these time-study folios should be used in the factory, and which is in general very instructive for the managers of firms. It would perhaps lead us too far astray to explain further in this place the contents of these folios; perhaps there will be another opportunity to explain these details.

The net result of this book to date has been astonishing. About eight thousand computers and time-study engineers have been trained through these courses. We estimate the number of workers in firms whose work is regulated on the basis of time studies by our former students at about 600,000. The reports which we receive from these firms are to the effect that their output (aside from that due to new machines or changed work methods) has increased on an average at least 20 per cent through the greater saving in labor. We find, as has already been well proved in America, that through time studies work processes are more carefully planned in advance, and that alone makes possible the attainment of a much greater output. We appreciate especially that the fatigue and exertion of workers must at the same time be taken into account. In no case must the increase in production be achieved at the cost of individual physical speeding-up in any injurious manner; that is directly prevented because well-planned work saves the worker.

This penetration of industry with the idea of time studies has brought about increasing demands in interested circles that we produce something further. Not alone from the metal industry in distant places but from all types of industrial life, demands are made upon us to work out fundamental principles of so-called Refa-folios; e.g., for the textile industry, the building trades, and so on. In the technical high schools and universities the results of the Refa movement are closely watched and many professors are engaged in allied studies. Upon the instigation of the director, Mr. Ludwig, of the firm of Siemens-Schuckert, systematic, scientific investigations of hand work, physical motions and physical performance, have been set on foot in a group composed of Refa teachers, high-school professors and other members of industrial circles. All groups interested in these questions have the greatest hope for the further development of our work. We have many difficulties to surmount, especially with as much political agitation as there is at the present in our country. In spite of this, however, we have the happiness to record that within a few years we have made advances far beyond our expectations. It would be a pleasure to us to be able to work on this question with interested American groups, and from the conversation with Mr. Person the author believes he may dare to hope for this.

A New Honorary Member

MAJOR-GENERAL WILLIAM CROZIER

ANNOUNCEMENT was made at the Annual Dinner of the Taylor Society at the Hotel Pennsylvania, New York, on December 4, that Major-General William Crozier had been elected an Honorary Member of the Taylor Society.

As guest of honor on this occasion Major-General Crozier reviewed his early connections with the scientific management movement both in the government arsenals and in the organization and workings of the Ordnance Department, of which he was the chief for so many years. In his remarks he paid tribute to Mrs. Crozier, who accompanied him as guest of honor at the dinner.

Major-General Crozier was born in Carrollton, Ohio, on February 19, 1855, and was graduated from the U. S. Military Academy at West Point in 1876. After miscellaneous service in the army he was appointed Brigadier-General Chief of Ordnance, U.S.A., in 1901, which position he held until shortly before the close of the War. He was retired as Major-General on December 31, 1918. He is the inventor of a wire gun and also, together with General Buffington, of the disappearing gun carriage. He has seen service in the Indian wars, has been a delegate to the International Peace Conference at the Hague, has served in the Philippines and in China and during the War spent several months in his capacity as Chief of Ordnance in the theatre of war in France and Italy.

Dedicatory Remarks

Upon the Presentation of a Frederick Winslow Taylor Memorial Window on November 17, 1929

By the **REV. WILLIAM L. SULLIVAN**
Pastor of the Unitarian Church, Germantown, Pa.

THIS BEAUTIFUL window of the Sower sowing seed not only calls forth your admiration as a noble adornment of this stately church but justifies your pride in a member of this Society whose name it commemorates. It is a memorial tribute to Frederick Winslow Taylor placed here by his widow. Mr. Taylor's mother became a member of this church soon after its foundation; and her son was one of the congregation until his death in 1915.

Frederick Taylor's life was so fruitful in great accomplishment that the world still does him honor. It is a life that it will do us good briefly to review. He had intended to devote himself to the law and he had begun to guide his studies toward that end. But a failure of eyesight turned him from the bar to industry and in industry it was that his profound and far-seeing mind achieved his great results and built his enduring fame. He saw perhaps more clearly, and certainly more practically, than any other man of his time that the constant strife and collision which afflicted industry then were wanton waste and a reproach to our intelligence. Why should not men live together peaceably in the day's work as they live peaceably together in the same street? Why should not fair minds and a moderate exercise of good-will remove disastrous friction here as they are removing it in all other relations of life?

Upon these questions Mr. Taylor centered his thought and to the answering of them contributed his beneficent solutions. In the day when the idea was a novelty he announced that there should be high wages and that there should be high production in order to make it possible to maintain them. Practical prosperity as well as theoretical justice required it. An industry, moreover, which was endangered by dissension demanded it. To showing the reasonableness of these proposals and to instructing us in the practical measures to make them effective he gave the rest of his life.

Scientific management is the term that is usually associated with Mr. Taylor's efforts. It is a term that must not be misunderstood. In itself and taken in isolation from his full interpretation of it, the phrase sounds impersonal and lacking in humaneness. But he gave no such meaning to it. He simply desired that work should be done in the best way for both workman and employer; that for exceptional service there should be exceptional reward; and that in the wide field of industry each contributor to the total result should do what he was most fitted to do; over all details stood the aim and end of a healthy rational industry with the welfare of every member inseparable from the prosperity of the whole co-operative enterprise.

This principle along with the means proposed for realizing it has had immense results. Mr. Taylor's writings have been translated into a great many languages. The nations of Europe and Asia which are desirous of laying the foundations of a wise industrial system are studying his ideas as they are studying the ideas of no other man in this department of life. And it is interesting to observe that Mrs. Taylor attends from time to time in Europe meetings held for the purpose of providing for a sound and generous industrial activity, and that there she sees her husband honored and his wisdom teaching still.

A fitting memorial to such a man is this pictured theme of the Sower sowing seed. The gospel parable pertinently applies to Frederick Winslow Taylor's life. The harvest of his thought and labor still grows and will continue to grow for many reapers to gather in. And you of this congregation may take legitimate pride in the remembrance of such a man and in the thought that some of his inspiration came from the free expression of the life of the spirit to which this Society is dedicated.

News of the Sections

University of California

The student group at the University of California held its first meeting of the school year on December 1 at the Faculty Club. Fourteen students attended to hear Dean Dexter S. Kimball, of Cornell University, who has been lecturing during the fall quarter at Stanford University. He discussed current developments in the management field. Dr. Flugel and Dr. Kelley of the University of California faculty took part in the discussion. At its next monthly meeting the group will welcome Dr. Robinson, who is spending the holiday period in Berkeley.

Eastern Massachusetts

This year the Eastern Massachusetts Section of the Taylor Society, which was reorganized last year in Boston, is holding monthly meetings in conjunction with the local group of the Society of Industrial Engineers and the Associated Industries of Massachusetts. At the meeting on November 17 Allan H. Mogensen spoke on "Applied Time and Motion Study." Close to two hundred people attended the meeting.

Central New York

The Central New York Section of the Taylor Society met in Syracuse on November 21 to hear an address on advertising by Ray O'Connell, who is connected with a large advertising agency, is a university lecturer on advertising and was at one time editor of an important trade paper.

New York Metropolitan

The meeting on November 20 at the Fraternity Clubs was given over to a discussion of "Research in Industrial Marketing." Eldridge Haynes, Marketing Counselors Staff, McGraw-Hill Publishing Company, Inc., was the speaker and Edward R. Dewey, Chief of Industrial Marketing Statistics, Bureau of the Census, Department of Commerce, and R. O. Eastman, President, R. O. Eastman, Inc., discussed the paper.

University of North Carolina

The student group at the University of North Carolina, numbering more than fifty in its membership, held its first meeting of the year on October 31. Over one hundred of the faculty and students were present to hear Colonel Rees, Assistant Vice President of the American Telephone & Telegraph Company, speak on "The Profession of Business Management."

Reviews

Life Expectancy of Physical Property. By Edwin B. Kurtz, The Ronald Press Company, New York, 1930, pages xiv, 205.

Many discussions of what fundamental methods should be adopted in depreciation accounting reveal that underlying the differences of opinion is a lack of verified and analyzed data as to the way the usefulness of physical property changes with age and use. The point of view of the author of this book is that a new method of attack on these problems is needed and that it is appropriate to develop fundamental methods for analyzing basic data before trying to define exactly what is meant by depreciation or to discuss what accounting procedure is preferable. As defined by the author, his main objectives are: to establish mortality tables of physical property on an actuarial basis; to develop the life characteristics of different classes of physical property; to develop the relations, and determine the laws between the various life characteristics.

Starting with an extensive collection of data on the retirements of physical property of various kinds and an explanation of the proper method of compilation of such data to permit actuarial analysis, the author develops a classification of the "mortality" curves, which show the percentage of the original physical units which remain in service after a period of years. His classification is based primarily on the closeness with which the lives of units in the group are concentrated about the average life. He then shows how to use one of Karl Pearson's frequency curves to smooth out accidental variations in the original data. He shows next that the Gompertz-Makeham mortality curve as used by the actuary fits satisfactorily the mortality curve for physical property and that average total life and average remaining life or "life expectancy" can readily be deduced for any given type of property after this curve has been fitted. As a special application, the author then analyzes the case of a large number of units put into service at the same time, with units which give out replaced year by year by new units subject to the same mortality law.

It may be regretted that the author did not consider it desirable to show more definitely how this material fits into the problems of the accountant or the general executive. Granted that the probable retirements of one thousand units put into service now will run about according to one of the laws stated, what amount should be set aside each year from current receipts to cover these retirements? Again, what light, if any, do Mr. Kurtz's studies throw on the proper depreciation charge for a single large unit whose efficiency is gradually decreasing? How can his methods be varied to allow for an increase in the tempo of obsolescence or for changes in the design of property now being installed as compared with the property for which mortality experience has been tabulated?

On the whole, in spite of the limitations noted above, this book makes a significant contribution to the study of depreciation and will serve, at least, as a useful source book for data and methods.

ROBERT W. BURGESS[1]

Wage-Payment Plans that Reduced Production Costs. Edited by Hugo Diemer, Mc-Graw-Hill Book Company, Inc., New York, 1930, pages x, 272.

Colonel Diemer in his book confined his discussion to eight plans usually applied to individual workers and five group incentive plans. Of the book's 272 pages all but forty-eight are devoted to the presentation of articles discussing features of various plans, features of management directly related thereto or presenting applications of such plans. His compilation of articles—comprising contributions of thirty authors—affords one a fairly comprehensive view of present-day practice in a variety of representative industries. Although Colonel Diemer confined his own writing to less than one-fifth of the book he sets forth in the first twenty-five pages a concise and easily understood statement of conditions that should precede the adoption of an incentive pay system and of what is essential to its successful operation. As is to be expected in view of his many and intimate contacts with Taylor and his work Colonel Diemer's discussion is in close accord with the principles and practices of scientific management.

Important and interesting as may be the descriptions of the various plans and of results achieved through their application it is to be regretted that Colonel Diemer should have limited his excellent statement of what he has termed "basic considerations" and "fundamental. . . plans" to so small a portion of the book. Brevity and conciseness of presentation are praiseworthy but the reviewer feels that the author has, as did Taylor in his writings, assumed a greater knowledge and understanding of the subject than his reader may be expected to possess. Few are so well qualified as Colonel Diemer with his background of practical experience and his close association with the scientific management movement throughout its evolution to analyze, codify and state the essentials of principle and technique upon which the efficacy and permanence of incentive wage systems depend. Anyone who has had experience in the field of industrial engineering will realize the crying need for recognition and understanding of these essentials by industrial heads whose judgment and opinion is too often beclouded by that dangerous thing "a little knowledge" and such men are confused by a multiplicity of wage systems put forth under the names of the men who have devised them.

Such systems in too many instances consist only of features of basic plans renamed and modified in such a manner as to make them appear to offer a new and less expensive easy path to the achievement of desired results.

That some incentive other than the fear of loss of his job or driving is essential if the worker's interest and effective co-operation in the attainment of a proper rate of production, finds ready acceptance. Likewise it is generally conceded that the most effective incentive lies in opportunity for financial gain: as Colonel Diemer says, "To the employe . . . the pay envelope has been and ever will be the supreme ambition. To him it means food, clothes, home, education for children, recreation and an automobile."

Too few, however, realize how important to the success of an incentive pay system, both in the measure of its accomplishment and permanence as well as in its effect upon relations between employers and employes, is the structure which supports the incentive wage plan. On this point Colonel Diemer says, "Certain prerequisites . . . are necessary to results. For these reasons, the installation of wage incentive systems means more knowledge and more studying than is entailed in an understanding of wage payment plans by themselves. The extra pay features of these plans, it is true, appeal to certain human desires, . . . which awaken interest and impel action, but in order to pave the way for these desires to get into action, intelligent and painstaking preparatory work is necessary before a wage system is installed." In a way this is saying that maximum production is dependent upon something more than the worker's unaided effort and involves many things beyond his control—a fact that was realized and preached by Taylor and his disciples from the very inception of scientific management. American management in general has been and still is too lazy to learn its own duties and responsibilities in connection with the attainment of possible increases in production. It ever seeks some short cut or royal road to results instead of the more arduous one of mastering and applying the principles and technique of scientific management and of establishing a mechanism and plan of organization, through which it will assume its responsibilities and afford the workman the consistent and effective co-operation essential to the greatest effectiveness of his efforts. The average executive is too ready to believe that if the workman, and perhaps the foreman, is offered an incentive that nothing more is necessary. Colonel Diemer makes specific reference to these principles and practices which grew out of or were concurrent with Taylor's efforts to develop a fundamentally sound incentive wage system based upon properly established standards of production and service to the worker. All of these he embodied in a consistent, fully developed and co-ordinated system composing what came to be known as scientific management.

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[1] Chief Statistician, Western Electric Company, Inc., New York, N. Y.

It is true that as Colonel Diemer says, "Most companies have already in effect a certain amount of standardization and production control." Too often, however, this consists in the mere application of the terminology of scientific management to an organization and system of operation which is half-baked, loosely hung together, deficient in many essential features and all based upon a superficial knowledge and frequently an erroneous conception of scientific management. The reviewer fears that readers in whose companies such a condition exists may misinterpret the statement that "these matters need not be developed to anything approaching the ideal of perfection" and hence may fail to duly heed the admonition that "Standardization and control must be developed to such an extent as is necessary in order to make the incentive system run smoothly." What the terms "Standardization and control," and "the ideal, or perfection" mean to one of Colonel Diemer's long practical experience, with his intimate knowledge of the subject, and what they mean to the majority of executives may be two vastly different things. These latter would profit greatly by a profound study of each of the basic features or essentials discussed in Part I of the book.

Part II of the book contains descriptions of the following which the author designates as the fundamental or best known plans:

Taylor's Differential Piece Rate
The Halsey Premium Plan
The Rowan Plan
The Gantt Task and Bonus Plan
Diemer Bonus and Premium System
Emerson Efficiency System
The Bedeaux Plan
The Towne Gain-Sharing Plan
Packard Motor Car Co. Group System
Hudson Motor Car Co. Group System
General Motors Group System
Standard Time System (Westinghouse)

The value of this section might have been further enhanced by an analysis along the lines of their basic features or characteristics, such as the reviewer attempted in some measure in his paper "Incentive Wage Systems" published in the BULLETIN OF THE TAYLOR SOCIETY.

In the reviewer's opinion such an analysis would have shown that of these twelve plans only three might be considered truly basic, these being the Taylor, Halsey and Towne plans. The others would appear to have grown out of the three in an attempt to combine in varying degrees the features of one with another. While some strange hybrids have resulted, in the main the tendency has been to strengthen and improve the plans originated by Towne and Halsey by injecting into them some of the Taylor technique, while attempting to avoid placing upon the management its full share of responsibility.

The articles contained in Part III, which makes up eight-tenths of the book, are interesting accounts of the application of a variety of incentive wage plans.

KING HATHAWAY[2]

The Federal Reserve System. By Paul M. Warburg, The Macmillan Company, New York, 1930, Vol. I, pages xix, 853; Vol. II, pages viii, 899.

This imposing work, running to two massive volumes of some 1750 pages in all, is a monument to the achievements of one who, in the opinion of Professor Edwin R. A. Seligman, has been responsible more than any single individual for banking reform in the United States during the past generation.

There are several books by able writers dealing with the organization, administration and practical operation of the federal reserve system, but the only works treating the genesis of the Federal Reserve Act have been written by pleaders of their own cause and not by unbiased historians. These writers have failed to give due credit to contributions of individuals and associations active in the formation of the Federal Reserve Act from 1908-1914. It was for the purpose of correcting errors, of giving due credit, of obtaining proper historical perspective with regard to the greatest piece of banking legislation in the financial history of the United States that Mr. Warburg was prompted to record the evidence coming within his experience.

Taking account of the state of opinion in which reform ideas grew he points out with painstaking care the obstacles which had to be overcome before any reform plan could be adopted; the contributions of individuals in formulating ideal or model plans, and of associations carrying on the educational work to the public before political recognition could be obtained. Prominent among others was his own plan of the *United Reserve Bank of the United States* which was destined to exert great influence, first upon Republican, and later upon the Democratic, measures which resulted in the Federal Reserve Act. He reviews the work of the National Monetary Commission, and the legislative proposal of the Aldrich Committee. Much space is given to a comparative analysis of the *National Reserve Association (Aldrich) Bill* and the *Federal Reserve Act,* even to the extent of juxtaposing the two clause by clause on opposite pages so as to show identical, similar or different phraseology and meaning; and these likenesses and differences are minutely analyzed. Contemporary correspondence and criticism enables the author to refute assertions made by others with regard to origins of significant features of the reserve act.

With regard to the operation of the new act Mr. Warburg also speaks with authority, since he served on the original Federal Reserve Board appointed by President Wilson (1914-1918), part-time as vice-governor. He shows how many provisions resulting from compromises failed to work well, and how suggested changes in policy and organization led to revisions, chiefly the so-called "war amendments" of June 21, 1917. These changes are shown in the addenda by the ingenious device of crossing out deleted material in the revised act, and indicating new alterations, amendments added, by italics in the text, with their appropriate dates in the margin. It is significant how many changes conform to original suggestions made by Mr. Warburg.

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[2] Manning, Maxwell and Moore, New York, N. Y.

The principal message of this book is that the federal reserve system is the product of the labor of many minds—non-partisan, Democratic and Republican; that it is still weighted down with the burden of political compromises which menace the future. In the light of changes which are still necessary Mr. Warburg pleads that the reserve system receive the undivided friendship and good-will of both political parties, and that all citizens feel an equal degree of concern and responsibility for its welfare. Indeed, he dedicates the volumes "to the guardians of the federal reserve system, past, present and future."

The reader should not be frightened at the size of these bulky tomes. The author describes his work as "reflections and recollections" and this form enables him to tell the story of a great financial reform movement with the vividness and breathing vitality which could be portrayed only by one who has lived through the events. The easy-flowing narrative is punctuated with anecdotes, and is replete with quotations from papers, addresses and letters from prominent people active in public life. The first volume may be regarded as complete in itself since it contains the historical part of the discussion down to 1927, with addenda on *The Chicago Incident* (a case of dictation by the Federal Reserve Board on the subject of rediscount rates in the Districts) and upon the *Stock Exchange Crisis of 1929* (another example of differences arising within the administration of the system). The remaining three hundred pages consist of appendices, documentary evidences referred to by the author in the text, interesting material in itself, but not essential to the story. The second volume consists of a collection of addresses and essays by Mr. Warburg between 1907 and 1924. These deal with problems touching the subject of banking reform and the federal reserve system, and with broad questions of domestic and international finance. They may, therefore, be read separately or as supplementary to the first volume.

JAMES WASHINGTON BELL[8]

Industrial and Commercial Ohio Yearbook, 1930, The, Bureau of Business Research, College of Commerce and Administration, The Ohio State University, Columbus, 1930, pages xii, 154.

The 1930 volume of The Industrial and Commercial Ohio Yearbook recently published by the Bureau of Business Research of Ohio State University contains considerable statistical information relative to the industries and commercial organizations of that state.

Anyone interested in a complete and comprehensive analysis of this market will find this book an extremely interesting and valuable contribution.

Collective Bargaining Among Photo-Engravers in Philadelphia. By Charles Leese, University of Pennsylvania Press, Philadelphia, 1929, pages x, 218.

Whether industry is to serve men or men serve industry is a question not yet answered. As yet, most men serve industry without being served by it except in a drab and niggardly fashion; only a few get from it sufficient income to enable them to attain any fullness of life. These fortunate ones are, for the most part, those owners and managers in whose hands the control of industry rests. For the vast majority of the underlying population of employes the per capita income—money and psychic—is nothing to write home about. But here and there are favored groups of craftsmen who enjoy differential advantages considerable enough to put their members well above the poverty line; giving them, significantly enough, an income status which many a small tradesman has reason to envy, even though the bigger and better business men would consider it mean and inadequate.

Such a favored group of craftsmen are the photo-engravers who, like most of their fellow workers in the other printing trades, enjoy earnings well above the average for manufacturing wage earners generally. This advantage is essentially monopolistic, the monopoly having been chiefly created by union organization of that scarce commodity called craft skill. Following the lead of their unionized employes the employers in the photo-engraving industry by organization have secured to themselves monopolistic advantages of a like kind. It is these craftsmen and their employers that have been selected for analysis by Dr. Leese. He has dealt, however, not with the photo-engraving industry at large but with this industry in the Philadelphia market only. This study is, in other words, a description and appraisal of industrial relations—union style—in the Philadelphia photo-engraving industry.

Dr. Leese describes his work as "a case study in labor relations" and he must be congratulated on having produced a painstaking, systematic, well documented description and analysis of his "case." He is dealing with a trade that requires of its members not only skill of a fairly high order but also at least so much of artistic ability as is required for good judgment of color values. He introduces his study, therefore, with a brief explanation of photo-engraving processes and an outline of the salient features of the industry; the small size of the average concern, the unusually great importance of labor as a factor in it and the somewhat inelastic demand which results in the possibility of pushing prices up considerably without great risk of loss of business.

Negotiations between the contracting parties are not national in scope but are roughly co-terminous with the respective urban markets of the industry. The immediate negotiating parties, nevertheless, are not wholly sovereign; they are local subdivisions of the respective national organizations of the parties, the employing photo-engravers' associations on the one side and the International Photo-Engravers' Union on the other. Dr. Leese therefore introduces his discussion of the dynamics of collective bargaining in the Philadelphia market with an outline of the structure, powers and functions of the national as well as the local bodies. Then follow four chapters which are concerned with the heart of the problem. In these chapters the author describes the formulation of the local agreements; analyzes the nature of the disputes concerning, and grievances arising under, the agreements; outlines the method of settlement of disputes and discusses the significant changes in the conditions of work with which collective bargaining in the industry has been concerned.

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[8] Professor of Money and Banking, School of Commerce, Northwestern University, Evanston, Ill.

The matters with which the parties have been most deeply concerned are the union shop, control of the labor supply, security and continuity of employment, the shortening of the work-week and changes in wages. It appears that the Philadelphia market is more strongly union than is the industry in other markets, since "about 95 per cent of the industry in the Philadelphia area works under closed shop conditions" (p. 131), whereas for the country as a whole the proportion is about 65 per cent. The work-week has been cut down from fifty-four or sixty hours at the time the union was organized in 1900 to forty-four hours. Wages, between 1913 and 1928, rose from $20 to $60 per week in the commercial branch and from $27 to $58 in the newspaper branch. It is evident then that the union's collective bargaining policy has been to center its attention upon higher wages, shorter hours and greater stability of employment and in this program it seems to have been markedly successful.

So far, so good; even though the going is heavy, stylistically speaking. What seems to the reviewer the most serious deficiency in the book is the almost complete absence of consideration of the effects of a quarter-century period of craft-union collective bargaining upon (1) per capita productivity (2) managerial efficiency and (3) business profits. We need to know much more than we do as to how "running union" compares with "running non-union" in respect to the efficiency of manager, craftsman and laborer, so that, if "running union" shows up unfavorably in these respects, it may be possible to consider intelligently what changes need to be made in union structure and policy in order to make unionism a force for efficiency as well as (what no one doubts it now is) an effective factor in improving the material welfare of workers.

The book contains an index, a glossary of technical terms used by photo-engravers, a short bibliography, an appendix containing the text of the constitution of the International Photo-Engravers Union and a copy of the 1928 agreement between the Philadelphia local of the union and the Manufacturing Photo-Engravers Association of Philadelphia.

Paul F. Brissenden[4]

Trade Associations—The Legal Aspects. By Benjamin S. Kirsh, Central Book Company, New York, 1928, pages 271.

As a social group we experience the normal human desire to have our cake and eat it. We are maintaining private ownership and management of enterprise. We want the benefits of competition and give our legal sanctions to assure them. We want the benefits of combination, but are afraid of its potentiality for evil.

In one economic area we have concluded that the evils of complete competition are too great to be endured, and in the public utility field have substituted for it a large measure of public control to guard against the abuse of monopoly.

The enterpriser in businesses that are not public utilities constantly seeks to gain the advantages of combination, and one of his ever pressing business problems is to attain them without violating the restrictions the law imposes. The engineers of one kind and another have been enormously busy, and in a large measure successful, in reducing the human and other wastes in production. No progress at all corresponding has been made in the process of marketing.

Trade associations are a device through which the enterpriser seeks the benefits of combination while still maintaining that freedom of competition which the law requires. The book under review presents the results of a careful inquiry into what lawful means trade associations may employ to attain the beneficial ends they seek.

Mr. Kirsh came to his task of writing with a background of practical experience in the problems involved gained as a Special Assistant to the United States Attorney in New York in the prosecution of Sherman Anti-Trust cases. The work throughout bears the impress of competence and careful consideration. It presents a hopeful attitude, encouraged by recent decisions of the Supreme Court of the United States, that trade associations may lawfully do much toward saving the social losses due to unstabilized industry. Any observer of economic phenomena knows that these losses are enormous through direct waste of capital by unbalancing commitments to particular industries leading to the indirect losses of economic crises, besides all the continuous wastes in marketing.

No better indication of the scope of Mr. Kirsh's book can be given than to state his chapter headings. They are:

I. Trade Association Law.
II. Trade Association Statistics.
III. Uniform Cost Accounting Methods of Trade Associations.
IV. Credit Bureau Functions of Trade Associations.
V. Patent Interchange.
VI. Foreign Trade Functions of Trade Associations.
VII. Uniform Basing Point Systems of Trade Associations.
VIII. Collective Purchasing Functions of Trade Associations.
IX. Standardization by Trade Associations.
X. Trade Relations.
XI. Restricting Channels of Distribution.

Under these topics Mr. Kirsh indicates the limitations the law clearly imposes and the directions in which a trade association may lawfully and properly go. For what is just and fair in these as in most matters of life we cannot wholly rely on the promptings of a Socratic daimon, or even a Christian conscience, but must take careful thought. To this end Mr. Kirsh, on the subject of trade associations, presents a valuable aid.

Hastings Lyon[5]

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[4] Assistant Professor of Economics, Columbia University, New York.

[5] Member of the New York Bar; Lecturer in Finance, School of Business, Columbia University, New York, N. Y.

Democracy: Its Defects and Advantages. By C. Delisle Burns, The Macmillan Company, New York, 1929, pages 217.

The Function of Reason. By A. N. Whitehead, Princeton University Press, Princeton, 1929, pages 72.

The Quest of the Ages. By A. E. Haydon, Harper & Brothers, New York, 1929, pages xiii, 243.

There are intellectual questions growing out of practical life today urgently calling for answer. The force of them is being widely felt by practical men no less than by professional thinkers. And the fact that there are in reality questions of philosophic import increases rather than lessens their interest for more and more people. Examples of such questions are: Is it really possible for science and the scientific method to become in some way a philosophy of all life to the point where one must accept the conclusion that the principle of sequential causation is not merely a description but is evidence that mechanism and mechanical causation explain all life? Is materialism therefore the logical derivative of the effort to be scientifically honest? Is the role of human purpose and desire thus shown to be illusory? Is the expression that human purpose takes in efforts toward democracy therefore equally fatuous, and is democracy an outgrown or inadequate method, process or ideal?

Mr. Delisle Burns, who is concerned in his book with the last of these questions, is already known to some American readers as an English social philosopher of remarkable acumen. In the present volume he is answering the critics of democracy both from the governmental and the more subjective points of view. His theme is developed in terms of English experience so that the book does not become so intimate or persuasive for American readers as the splendid comparable work of T. V. Smiths on "The Democratic Way of Life." But he does make a strong, clear and psychologically sound case for the democratic method as the way of assuring development and power in the generality of individual lives. His warnings about conserving the value of original, pioneering personalities are specially timely. "There are some," he says, "who would not be happy in heaven—even a heaven devised by themselves. They are not sociable, for they think and feel most keenly alone. . . . It would be disastrous if a democratic society could not find a place for such men and women, for they make revolutions, and they are also the best artists and scientists. . . . They are the growth-points of a community." The point of view of this essay is in harmony with the best modern thought which says that however groping may be our attempts to translate democracy into forms of effective self-governance, the ultimate objective of developing, training and challenging each individual to his best accomplishment is unassailable and proves itself by its results.

Professor Whitehead, as one of the most eminent of modern scholars, edifies us in this long address with a statement about reason which supplements the somewhat comparable pronouncements of Professor John Dewey in a helpful way. Discussing the uses of science he says that "as a methodological device it is an unquestioned success so long as we confine attention to certain limited fields." But he questions "the authority of science in the determination of the ultimate categories of explanation." By way of building up his case for the actual efficacy of speculative and practical reason he reminds us that "one main law which underlies modern progress is that, except for the rarest accidents of chance, thought precedes observation." This is one of the clearest and simplest of Professor Whitehead's writings and it can be heartily recommended for lay reading by those endeavoring to clarify their minds on the several questions suggested above.

In a similar spirit and vein, but carrying his discussion much more directly into the field of conduct and human purpose, is Professor Haydon's analysis of religion as essentially the "shared quest of the good life." This book has a significance for today that is hard to overstate. It is an answer to much futilitarian thinking and feeling. Krutch's "The Modern Temper" represents the kind of utterance which, in a quite uncontroversial way, it is in effect replying to. The book is positive and hopeful in tone; but it is strictly objective, historical and dispassionate in its tracing of the multiform efforts to improve human life down through the ages. It reaches no easy conclusion; and is essentially "tough-minded" in its outlook. But for many who have today thrown over what William James called "over-belief" by the score, the book is immensely helpful in revealing the final kernel of faith or hope or vision that remains. It is strongly recommended to all who "have no use for religion" but are willing to admit that efforts to improve the quality of human living are still valid, still consonant with a scientific outlook on nature and human nature.

These three are admittedly books that carry us into the profound yet troubled waters of cogitation upon life's meaning, value and significance. But in an hour when spiritual unrest, confusion and anguish are so widespread, there is point in the occasional consideration of matters that go beneath and behind methods, and deliberate upon the assumptions on which those methods rest and on which also the successful use of methods depends—whether those methods be in the field of scientific management or of any other human institutional activity. For this reason each of these books is of value for that practical scientist, engineer or executive who finds he cannot refrain from occasionally asking—what is life all about, anyway?

ORDWAY TEAD[6]

Economic Democracy. By Robert S. Brookings, The Macmillan Company, New York, 1929, pages xxviii, 151.

This companion volume to *Industrial Ownership* commands attention because of its predecessor and because of the author's personal standing in the fields of practical business, public service and theoretical economics. The book is a collection of articles written or speeches delivered upon occasions where some significant economic or political problem was the subject of discussion. This form is utilized in order to add weight to the argument, but the author's main theses are maintained throughout.

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[6] Editor of economic and business books, Harper & Brothers, and lecturer on personnel subjects, Columbia University, New York, N. Y.

The author discusses co-operation versus competition in business practice, big business and the public, the tariff in its relation to a European economic union, the relation of raw materials to peace and prosperity, agriculture, overproduction, industrial management, education for political leadership and industrial defense.

Within this range of subjects the author has opportunity to set forth his independent and trenchant ideas. His statements that have attracted wide attention in *Industrial Ownership* are matched by similarly significant ones in this volume. For example, he says,

> The economic well-being of a people depends entirely upon the amount of their production per capita.
>
> Production per capita depends upon the division of labor, the adoption of labor-saving devices, the standardization of mass production, and the achievement of economy in distribution.
>
> The distribution of standardized mass production is primarily dependent upon the existence of a wide home market.
>
> Extensive home markets are made possible only by a customs union between states of adequate population with co-ordinate interests and a wide distribution of production among the people.

And again:

> If we could only form the habit of visualizing international trade as analogous to double-entry bookkeeping, where each dollar of import must show a corresponding dollar of export (either in commodities, services, or credits which we discuss as visible and invisible items), it would probably save the world a lot of waste resulting from a lack of clear thinking.

And:

> Considering the vital importance of wisely solving the tariff problem the Tariff Commission should have, in my opinion, advisory supervision over all tariff matters and should function as a scientific body as independent of political parties as is the Supreme Court of the United States.

Similar excerpts might be quoted from his other chapters. The discussions of the relations between labor and capital and of agriculture are peculiarly far sighted, constructive and hopeful. One closes the book with profound respect for a man of such practical affairs and such vision.

MOLLY RAY CARROLL[7]

Psychology for Students of Education. By Arthur I. Gates, The Macmillan Company, New York, 1930, pages xv, 612. (Revised Edition).

This edition replaces the 489-page 1923 edition. The general arrangement of the book is the same. The organism as a reacting mechanism is described in one chapter instead of three as before. Heredity, growth, and development are discussed in 113 pages as compared to 71 in the earlier edition. Motivation gets 72 pages, instead of 26. The discussion of learning is increased from 191 to 233 pages, and the results of measurement are presented in 115 pages where 85 pages sufficed in 1923.

Although the general arrangement is the same, the book is nevertheless materially revised, in that it has been brought up to date. There are over twice as many references at the ends of the several chapters as there were in the 1923 edition, and two-thirds of them have been published since the earlier edition appeared.

Some of the changes which characterize the revision are: less neurology, omission of the chapter on conscious states, greater recognition of maturation as a factor of development, description of certain urges as practically universal and important rather than as instinctive, greater emphasis upon the development and adjustment of the individual pupil, justification of the Law of Effect based upon its practical value, rather than upon its adequacy as an explanation, greater recognition of the importance of concomitant learnings, omission of statistical definitions, fuller treatment of achievement and capacity and of personality.

J. W. TILTON[8]

Electrical Utilities: The Crisis in Public Control. By William E. Mosher and Associates, Harper & Brothers, New York, 1929, pages xx, 335.

Part I of this volume describes the methods by which the public interest in the utilities is represented through commission regulation, under the conditions of private organization of the operating companies and the far-flung system of holding companies, also in relation to the increasing significance of interstate movement of electricity. The study applies generally to utilities, notwithstanding the limited title with respect to electrical utilities.

Part II is devoted to "consideration of various types of public control that might contribute to the solution of the crisis described in Part I." The several types included are control through contracts, public competition, control by league of municipalities, and control through a national planning commission. The discussion of contracts is based largely upon proposals made in Massachusetts and upon the Boulder Dam and Muscle Shoals bills. Under the league of municipalities, a survey is made of the Ontario Hydro-Electric System, while the plan of the English Central Electricity Board is presented under the national planning commission.

The outstanding chapters are the first three, which take up control through public service commissions, the role of the courts in regulation, and the structure, functioning and control of holding companies. The description of the commissions, together with discussion of their functions and procedures, viewed from the public standpoint, is the best that has been presented in any book to date. The second chapter follows generally the analysis that had been previously made by the reviewer.[9] The chapter on holding companies brings together compactly and clearly materials that had been widely scattered. The three chapters together well justify the book.

The title raises the question whether there actually is a crisis, or in what sense there is a crisis in public control. Except for the concluding chapter in each part, one would hardly gather from description and discussion that there is such a serious situation as to amount to a "crisis." But we are told (p. 188) that "such control as exists is not far from the breakdown stage," and that "all of the factors of the crisis as cited above call for prompt and positive action." In the last chapter (p. 293), we learn that "there can be no doubt but that we stand at the parting of the ways. One road leads to governmental regulation in the public interest and the other to a minimum of regulation in the interest of controlling stockholders. Such is the crisis."

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[7] Executive Head Resident, University Settlement, Chicago, Ill.

[8] Assistant Professor of Educational Psychology, Yale University, New Haven, Conn.

[9] Bauer, John, *Effective Regulation of Public Utilities*, New York, The Macmillan Company, 1925, Chapter V.

If "crisis" means that the present system of regulation has developed serious defects, and that it has not worked out as satisfactorily as had been expected twenty-five years ago, I certainly agree with the authors. In a limited sense I agree also that there has been a breakdown of regulation—that it has not furnished the protection of the public as had been expected, and that it works imperfectly as an instrument of public policy. And the need of effective regulation is apparently attracting increasing public attention throughout the country. Already, distinct movements have started for comprehensive revision of existing state systems. In New York, for example, during the past year a special legislative commission made a survey of regulation, and reported to the legislature what changes should be made. The requisites of effective regulation will doubtless be one of the pressing public problems in New York for the next few years. Similar movements, although less comprehensive, have been started in Massachusetts, Wisconsin, Texas, and other states.

The fact is becoming recognized increasingly that there are basic defects in our present system of regulation, and that revision is necessary as to fundamental policy, standards and machinery of control. But that the present system is "not far from the breakdown stage," or that we actually "stand at the parting of the ways," is subject to debate. Undoubtedly, trenchant criticisms will continue to be made, and the statutes will gradually be modified. The policy of a fixed rate base and returns may be adopted, and systematic administrative machinery may be provided. But these changes will hardly proceed precipitately, and but few people will recognize a crisis. I surmise that we shall flounder along under conditions that are unsatisfactory, but might be worse, and that gradually we shall make improvements—but shall be a long time achieving the standards of regulation that some of us see as desirable in the public interest. If what we want is painfully slow in coming, is that to be taken as a crisis and the parting of the ways?

Although there is presented a clear and interesting description of the present system of regulation, the authors fail to show just how the system should be revised to make it effective. They present the possibilities of complementary methods of control, but they do not appear to recognize what to the reviewer appears to be the fundamental fact—that effective regulation requires the institution of definite standards of measurements and appropriate administrative machinery. The institution of such standards constitutes the vital problem which has been almost completely overlooked by the authors.

John Bauer[10]

Unemployment. Bulletin Number 104 of the Russell Sage Foundation Library, 130 East 22nd Street, New York, December, 1930, pages 4. ($.10)

This list of references on unemployment takes on special significance at the present time.

It tells where the best bibliographies on the subject can be found and gives a selected list of recent periodical, pamphlet and bound material on how to deal with the emergency in its various aspects. The eight-point matter that summarizes many of the listings adds to the usefulness of this sheet, which should be in the hands of all our industrialists.

Secretary's Guide to Correct Modern Usage, The. By C. O. Sylvester Mawson, Litt.D., Ph.D., Thomas Y. Crowell Company, New York, 1930, pages 213. ($2.00)

This latest book to take its place on our "secretary's" reference shelf is a revision of an earlier work by the author who is an English scholar and a lexicographer of some note. Its material, which is compactly arranged and well indexed, is designed primarily as an aid to the secretary with editorial and proof-reading duties. It contains chapters on Style, Diction, Type Spacing, Sizes and Styles of Type, Preparation of Manuscript and Proof Reading, as well as specific rules and examples of spelling, the compounding of words, abbreviations, punctuation, etc. Its glossary of typographical terms is also helpful. The usual confusing contradictions appear and the arrangement of the last half of the book could perhaps be improved upon, but the book is without question an office asset.

Books Received

**Evolution of Industrial Organization, The.* By B. F. Shields, Isaac Pitman & Sons, New York & London, 1930, pages xv, 414. ($3.00).

**Foundations for Human Engineering.* By Charles R. Gow, edited by F. Alexander Magoun, The Macmillan Company, New York, 1930, pages xiii, 226. ($1.60).

**History of Science, A.* By William Cecil Dampier, Dampier-Whetham, The Macmillan Company, New York, and The Cambridge University Press, Cambridge, 1930, pages xxi, 514. ($4.00).

**Menace of Overproduction, The.* Edited by Scoville Hamlin, John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1930, pages x, 202. ($2.25).

**Planning and Control of Public Works.* Report of the Committee on Recent Economic Changes of the President's Conference on Unemployment, including the report of Leo Wolman of the National Bureau of Economic Research, Inc. By Leo Wolman, National Bureau of Economic Research, Inc., New York, 1930, pages xxviii, 260. ($3.00).

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[10] Director, The American Public Utilities Bureau, New York, N. Y.

*To be reviewed later.

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IF management is a science, it will at least do two things. In the first place it will make an endless search for facts, and in the second place it will interpret these dispassionately but with imagination.

Editorial in
Industrial Welfare and Personnel Management
London, September, 1930

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